PUBLIC WORKS

Devoted to the interests of the engineers and technical officials of the cities, counties and states

DECEMBER, 1938

A. PRESCOTT FOLWELL, Editor — VOL. 69. NO. 12 — W. A. HARDENBERGH, Asso. Editor

Contents

The Index for the year 1938 will be sent to subscribers on request.

TIMEWASTERS

Dear Mr. Editor:

I read with some interest the analysis by Mr. Wolverton of Dora's age, and insist that figures did not lie in this instance but rather that Mr. Wolverton mistook the statement of the problem. The correct equation for solving the problem is as follows:

$$28-(x+4)-2\,[(28-(28-x)-5)-(28-x)]$$

from which $5x=90$

$$x=18$$

The problem did not state when Dora was 5 yrs. younger, but rather when Dumb was 5 yrs. younger than Dora is now. On analyzing Mr. Wolverton's results: Dora 11 1/3 hrs. old and Dumb 28. Four years before Dora was born would have been 15 1/3 years ago. Difference in ages 16 2/3 yrs.

When Dumb was 5 yrs. younger than Dora, would have been 21 2/3 yrs. ago, but says Dora, "At this time 21 2/3 years ago, my age was ½ of what yours was 4 years before I was born," but from the above figures with Dora only 11 1/3 years old, 21 2/3 years ago was 10 1/3 years before she was born. The correct answers are 28 and 18; 4 years before Dora was born, would be 22 years ago, at this time Dumb was 6. When Dumb was 5 years younger than Dora is now was $(10+5)=15$ years ago, at which time Dora was $(18-15)=3$ years old. The error in Mr. Wolverton's analysis was that the time he took was, when Dora was 5 years younger than she is now, instead of when Dumb was 5 years younger than Dora is now.

A. A. Reichstein.

A Log Problem:

The *Pioneer*, house organ of Electro Bleaching Gas Co., says that the following little problem is well-nigh unsolvable. But our own Mr. Folwell read it right off. Here it is:

$$\log 62.5 + \log x = 3$$

The idea is to solve the equation for x without using any log tables. We are given to understand that this also bars slide rules with log scales, and that all claims to knowing mantissas by heart will be disallowed.

Mikey & Ikey:

Mikey was as old as Ikey was when Mikey was as old as Ikey was when Mikey was as old as Ikey is now. When Ikey becomes twice as old as Mikey is now, the combined age of Mikey and Ikey will be 51 years. How old are they now?

A Merry Christmas and a Happy New Year.

W. A. H.

SUBSCRIPTION RATES: United States and Possessions, Canada, Mexico and Cuba, $3.00. All other countries, $4.00. Single Copies, 35 cents each.

FOUNDED IN 1896

Published monthly by the PUBLIC WORKS JOURNAL CORPORATION, 310 E. 45th St., New York, N. Y. J. T. MORRIS, *President;* W. A. HARDENBERGH, *Vice-Pres.;* CROXTON MORRIS, *Treasurer. Advertising Manager*, ARTHUR K. AKERS, 310 East 45th St., N. Y. *Advertising representatives*, FRED R. JONES, 228 No. La Salle St., Chicago, Ill.; ALONZO HAWLEY, 1635 E. 25th St., Cleveland, Ohio.

PUBLIC WORKS Magazine . . DECEMBER, 1938

Vol. 69, No. 12

Four-State Agreement on Delaware River Pollution

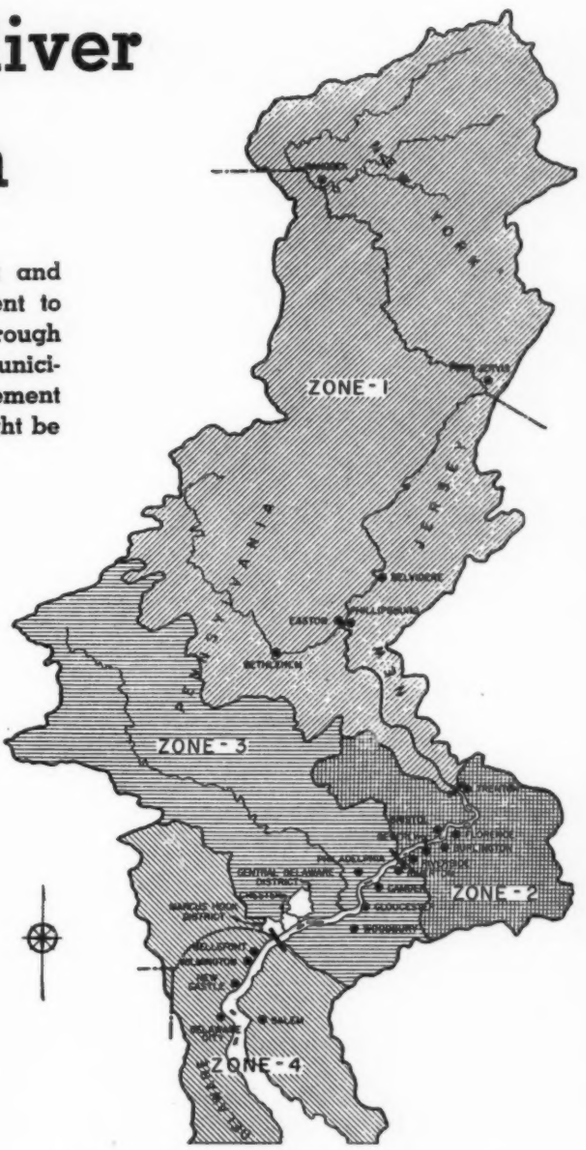
Four States—New York, New Jersey, Pennsylvania and Delaware—have entered into a reciprocal agreement to limit the pollution of the Delaware river, which flows through or along all of them. The limitations placed on the municipalities of these states in accordance with this agreement are described. Other states with similar problems might be aided by a study of this solution.

THE Delaware river rises in New York State and flowing southward to the sea, forms the boundary between the states of New York and Pennsylvania, then between Pennsylvania and New Jersey, and finally between New Jersey and Delaware. The courts have decreed interstate ownership of this waterway, which implies the necessity of interstate control, and in 1936 there was organized the Interstate Commission on the Delaware River Basin, which is a part of the governmental machinery of the cooperating states, to formulate and execute a coordinated, unified plan looking toward the wise use, development, and control of the natural resources of the river basin as a whole.

Each state has agricultural, residential, industrial and recreational interests in the river, in varying degrees. All pollute it and all desire to use water from it for public supplies. An equitable allotment of quantity for the latter purpose must be made, but of most immediate importance to all is the correction and control of the pollution of the water which threatens to render it unfit for such purpose.

The river basin has an area of more than 12,000 square miles, on which live about 5 million persons. But New York and New Jersey use or are preparing to use vastly more water outside the basin than in it, diverting it to New York City and the cities of eastern New Jersey; so that more than 10 million persons are interested in its quality, although less than 5 million contribute to its pollution.

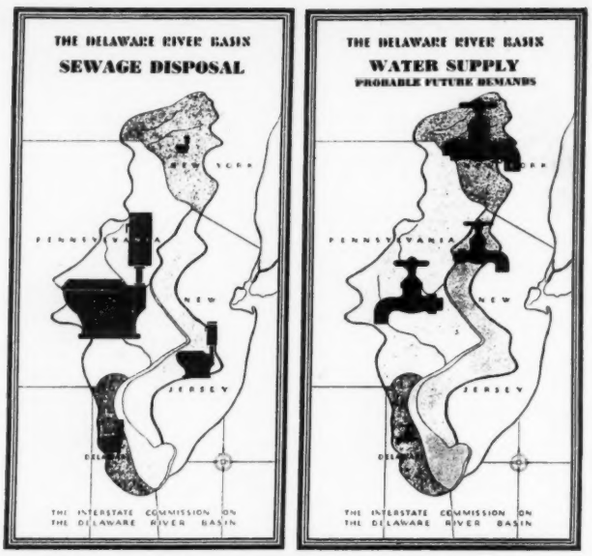
With a view to controlling the pollution, the Interstate Commission drafted a reciprocal agreement, which has this year been ratified by the Departments of Health of the four states. The main provisions of the agreement are given below in condensed form.



Delaware River Basin, showing zones in which minimum standards apply for the control of pollution of the river.

Provisions of the Agreement

Interstate Cooperation. Each state agrees to enact and enforce adequate legislation to enable it to require such treatment of sewage and other polluting matters as will be necessary to keep the river, and its tributaries just above their confluence with the river, in the clean



Relative amounts of sewage discharge and water requirements by the four states respectively

and sanitary condition required by the provision of the agreement.

Zoning of the Basin. Due to such variable factors as location, size, character, flow, and uses made of the water, no single standard of quality is practicable for all parts of the river, nor, therefore, for the treatment of the waste waters entering it. Therefore the river was divided into four zones, as shown on the accompanying map.

The drainage basin of Zone 1 contains few sewered communities or industries producing waste water; the streams in it are, in general, relatively clean and adapted as sources of public supplies, and the principal uses of it are expected to be for water supply, recreation, fishing and agriculture.

Zone 2 is more densely populated, contains more sewered communities and industries, and will probably be used for the same purposes as Zone 1 plus navigation and industrial purposes.

Zone 3 contains populous metropolitan areas, including Philadelphia, and the principal uses of the river are expected to be for navigation and industrial water supply; but the water should not be unfit for use as a source of water supply if purified, nor harmful to fish life, nor adversely affect the quality of the waters of the tidal tributaries.

Zone 4 is the tidewater zone. Here the principal uses of the river will be for navigation, industrial water supplies, commercial fishing, shellfish culture and recreation.

Minimum Requirements. No sewage or other polluting matters are to be permitted to enter the river unless they have first been so treated as to produce effluents which meet the following minimum requirements.

Zone 1. (1) Effluent free from noticeable floating, color, oil, grease or sleek, and practically free of suspended solids. (2) Shall not cause noticeable turbidity in the river. (3) Shall show 85% reduction in B.O.D., with a B.O.D. in no case exceeding 50 p.p.m.; and shall not reduce the dissolved oxygen content of the river more than 5%, averaged for not less than 6 consecutive days. (4) The number of organisms of the Coli Aerogenes group in the effluent shall not exceed 1 per m.l. in more than 10% of the samples tested by the confirmed test and no single sample shall contain more than 100 in one m.l. (5) There shall not be sufficient acid, alkaline or other toxic or deleterious substance to create a menace to public health through use of the water for public water supplies, recreation, bathing, agriculture and other purposes; or to be inimical to fish, animal or aquatic life. (6) It shall be free of offensive odors and of substances capable of producing offensive tastes or odors in public water supplies taken at any place below the discharge of the effluent.

Zone 2. (1) and (2) as for Zone 1. (3) as for Zone 1, except that the B.O.D. limit is 100 p.p.m., and the reduction in dissolved oxygen of the river is 10%. (4) as in Zone 1, except that not more than 25% of the samples shall show more than 1 Coli Aerogenes per m.l. (5) as in Zone 1, except that bathing and agriculture are omitted from the uses of the river, and industrial purposes added. (6) as in Zone 1, except that the effluent shall not affect supplies taken above as well as below the point of discharge.

Zone 3. (1) as in Zone 1. (2) Shall not cause "substantial" turbidity after dispersion in the water of the river. (3) 55% reduction of total suspended solids and 35% of B.O.D. "(It is the intent of this require-

(Continued on page 24)

	Zone 1	Zone 2	Zone 3	Zone 4
Floating Materials	Free of noticeable floating solids, color, oil or grease. Free of sleek; practically free of suspended solids	Practically free of sleek and suspended solids	Free of noticeable floating solids, oil or grease; substantially free of suspended solids and sleek	
Turbidity	Sufficiently Free of Turbidity to avoid causing in the river. Noticeable turbidity		Substantial turbidity after dispersion	
Organic Substances, Suspended Solids	85% reduction in B O D. Limit of B O D 50 ppm	Limit of B O D 100 ppm	55% reduction in total suspended solids. 35% reduction in B O D (or enough to secure 50% oxygen saturation in the river)	Enough further treatment to prevent nuisance
	Reduction of dissolved oxygen in the river water. Not more than 5%	Not more than 10%		
Bacteria	Not more than 1 coli aerogenes per ml in more than 10% of samples. No sample more than 100 in 1 ml	25% of samples	Treated with a germicide if discharged within 2 miles or prejudicial influence of a public waterworks intake	Prejudicial influence of public waterworks intake, recreational area, shellfish area
Acids, Alkalis, Etc	Sufficiently free of acids, alkalis and other toxic or deleterious substances so that it will not menace or be inimical to			
	Safety of public water supplies, recreation, bathing, agriculture, fish, animal or aquatic life	Safety of public water supplies, recreation, industry, fish, animal or aquatic life	Safety of public water supplies, industry, or fish life	Safety of public water supplies, commercial fishing, shellfish culture, recreation, industry
Odor and Taste	Free of offensive odors, and of substances capable of producing offensive tastes and odors in public water supplies taken at any point in the river. Below effluent outlet	Above or below effluent outlet	Practically free of substances capable of producing offensive tastes or odors in public water supplies derived from the river	

Minimum standards adopted for the four zones into which the Delaware River Basin has been divided

William T. Morrissey

Boston Keeps 700 Miles of Streets Free From Snow

BY WILLIAM T. MORRISSEY

Division Engineer of Highways, Public Works Dept., Boston, Mass.

THE city of Boston has 700 miles of streets from which snow must be either plowed or removed during the winter season.

Snow plowing and removal operations are under the direction of the Commissioner of Public Works. The Division Engineer of Highways is directly in charge of the work, aided by the following assistants:

3 Division Engineers (of the Sewer, Bridge and Ferry, and Water Divisions)
1 Chief Engineer (Highway Division)
1 Chief Inspector (Highway Division)
1 Supervisor (Street Cleaning Division)
1 Superintendent of Garages & Auto Maintenance (Highway Division)
10 District Foremen (Highway Division)

These have under their immediate jurisdiction and control a working force of city employees, such as subforemen, inspectors, etc.

Snow Plowing

Part of the equipment used for snow plowing is owned by the city and part is hired. The city has a total of 247 plows available for snow plowing, these being of Baker, Walsh-Holyoke, Good Roads, Frink, Ball, Monarch and Sargent manufacture. Fifty-eight of these are attached to the city's trucks, and the remaining 189 are attached to contractors' trucks. The city-owned trucks do the plowing in the city proper, and the contractors' trucks are assigned to the outlying districts.

In addition to the above equipment, we have 16 Barber-Greene and Nelson snow loaders; 6 tractors, and 155 trucks ranging from 1½ to 10 tons, the heaviest being Walter and Four-Wheel-Drive.

As a general rule, this city's snow troubles do not start until sometime during the latter part of November, but the planning and organization of forces and equipment start during September, when bids are opened for contract snow removal and contractors' trucks for plowing are contracted for.

Contractors' trucks used for plowing must be at least 5-ton and in first-class condition. The contractor supplies with each truck a skilled chauffeur and a helper (paid $6.00 and $5.00 per 8-hr. day, respectively, with time and a half for overtime), and suitable repair tools. He is paid $5.00 per hour while actually plowing, with a minimum payment of $20, which he receives if he reports for plowing, even if sent back without doing any.

When a truck is accepted for use, it reports to the municipal garage, our main headquarters for snow work, where it is checked for tonnage, fitness and registration and the permanent equipment for attaching the plow is put on. The contractor stores the plow in a location suitable for immediate attachment to the truck when it is called for duty, and furnishes the city with his day and night telephone numbers and name of the party to be notified. This information is card indexed and the contractor is notified what district his trucks will plow in.

Weather reports are received at our municipal garage headquarters from the local United States Weather Bureau, and the Commissioner of Public Works is kept informed of the weather conditions. He issues the orders for beginning plowing, and the district foremen are notified from headquarters, and they, in turn, notify the contractors who have been assigned to their district to report to the paving yard to start plowing. The driver of the truck is given a printed route card which has thereon a list of streets his truck has been assigned to plow. The plows are followed up by the district foremen and inspectors, who have master cards of their routes.

During plowing operations, the district foremen from time to time report to the municipal garage headquarters as to how the plows are performing and how much of each route is completed in their respective districts. This method keeps us fully informed as to just how the plowing work is progressing. The plows are kept at work until they have cleaned up their routes. The trimming up in the districts is done by city-owned plows after the contractors' plows have finished. In the event of a very heavy snow fall, the city sends its own 7-ton and 10-ton trucks and tractors into the outlying districts to open one roadway through the street, and the 5-ton truck plows then follow through.

From experience I have learned that the sooner the plowing is started in this city the more money is saved, as the temperature here rises and drops very suddenly and we must try to avoid cradle holes and ruts. We start plowing in this city when approximately two inches of snow has fallen.

Snow Removal

While the storm is going on it is decided as to whether or not it is advisable to order the snow re-

Boston, Mass., uses 247 snow plows, 16 snow loaders, 6 tractors and other equipment. Snow removal is let by contract and the method (fully described) of keeping a record of the quantities has been developed from many years' experience.

moval contractors out. This is always necessary when we get a storm greater than six inches in depth. For snow removal purposes, the entire intown, business and Back Bay sections are divided into four districts, the removal of snow from which is awarded by contract to private contractors. An exception is a portion of our shopping district, which is handled by our own street cleaning forces.

Contracts for snow removal are awarded to the lowest bidder who can satisfy the Commissioner of Public Works that he has the necessary equipment to carry out his contract satisfactorily. Bids are at a cubic yard removal rate, the contractor supplying all equipment, labor and dumps.

Our contract removal districts are handled by division engineers.

The individual in charge of any equipment, whether hired or city-owned, must submit a daily report showing the registration number of the vehicle and the hours same has worked. This report form is mailed into the general office in City Hall Annex at the end of each day's work, and the information thereon transferred to record cards bearing the registration number of all hired vehicles, which are on file in this office. This system was put into effect three years ago and has proved of great service to the city, as it has done away with the practice of a contractor working two trucks with one set of registration plates, together with the stopping of a great many other irregularities. (The operation of the system is described in the accompanying "Instructions for Contract Snow Removal.")

As practically every section in the outlying districts has its own shopping centre, it is just as necessary to remove the snow from these districts as it is in the intown section of the city. It is also our practice to remove snow from in front of all churches, public buildings and in front of residences from which funerals are to be conducted. All the above-mentioned work is handled by city forces and hired trucks. In the event of a heavy fall of snow, these forces are augmented by emergency men, who are hired at the various paving service yards, given a button which identifies them by number, and assembled into gangs and dispatched to the various sections.

Our greatest problem in this city is the dumping of snow, as we really only have one good location that can handle the equipment we put out in a big storm, and that is a part of the waterfront for a distance of approximately one-half mile. The contractor who has the largest removal district uses mostly land dumps, in which he puts bull dozers to push the snow into piles. Other contractors use scupper holes from the bridges, which are fairly successful. Large sewers are used but, since the advent of the truck, they cannot handle the amount of snow like they could in the days of the horse and wagon.

The Boston Elevated Railway, which operates cars and busses in this city, has a working agreement with the city on snow plowing and removing. On their bus routes, they plow one-half the mileage and the city plows the other half. On the streets with car rails, the company does all the plowing for a distance of ten feet from the outside rail and the city plows from there on. In the *removal* of snow from these streets, the city removes the greater portion, but on certain car track streets the company supplies the snow loaders and the city supplies the trucks and labor. This has been working out very well for a number of years.

The narrow streets in intown Boston, together with the very heavy traffic on these streets, slow up our snow removal operations so that we are compelled to do most of the work at night after regular business hours.

When we are working on snow removal we labor continually throughout the entire twenty-four hours of the day, with fresh relays of men every twelve hours. Snow cannot be piled or heaped in any of our streets; it must be all carried away to either the waterfront dumps or to inland dumps. Every street in Boston is plowed and open to traffic a few hours after the snow stops falling. The citizens of this city expect this service, and it is our job to see that they get it.

Sidewalk Cleaning and Street Sanding

Relative to sidewalks, the city does not do any plowing or removing except in cases where the property belongs to the city of Boston. This is a matter which is regulated by law and it is up to the abutting owner to take care of this snow removal.

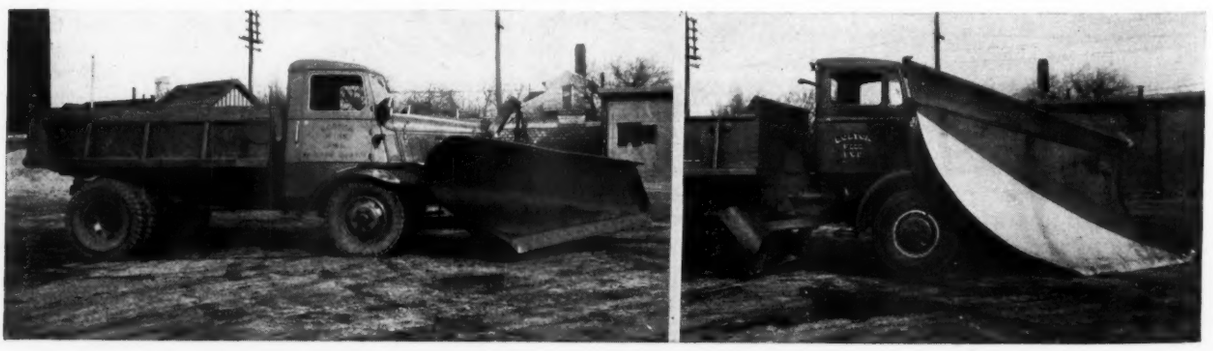
The sanding of streets today in this city has developed into a large problem. We use a mixture of calcium chloride with sand in the city proper, but have been more successful with the use of cinders mixed with some salt in the outlying sections of the city. This work is done from trucks by city forces, who spread same with shovel and some sand spreaders.

Instructions for Contract Snow Removal

The plate holder to be used consists of a permanent metal frame with three independent changeable metal sections. The top metal section will be embossed to denote District Number and the vehicle number; the bottom metal section will be embossed to denote the vehicle registration number and the cubic yard capacity of the vehicle; the side section which has previously been numbered, will be used to denote consecutive load numbers for each load of snow and will be known hereafter as the "load plate."

At the beginning of each storm the Department will send to each of the measuring stations a hand embossing machine to be used by the District Engineer in charge of the particular District, and will also send to each dumping station a sufficient number of small hand-imprinting machines with a time clock attached, to be used by the Dumping Inspectors. The Engineers, Loading

(Continued on page 24)



Two types of snow plows used in Boston

Left—General view of Killdeer sewer job. Right—Pouring concrete for Imhoff tank at Killdeer using home-made hoist. Tank was sunk 25 ft. as a caisson.

City Finds Many Uses for Gas Operated Hammer

By R. F. MIRICK

Some large cities can afford to own all kinds of gadgets, each for a special purpose. But smaller places, with less use for equipment, have to make one serve several purposes. This North Dakota municipality owns one which it has used for both excavating and tamping a sewer trench, driving sheet piling and breaking up concrete; and at an operating cost less than a dollar a day.

WHEN Killdeer, N. D., a city of about a thousand population, started work on a sewer construction project about a year ago, it purchased a gas hammer. In the summer of 1937, the contractor who was building a sewer system at Watford City (some 30 or 40 miles away) had used a gas hammer for taking out about 550 yards of rock and for tamping the backfill, and his experiences were so satisfactory that the purchase by Killdeer resulted.

The Killdeer job was a WPA project. The rock encountered in the work is a hard, sandy limestone which softens somewhat after exposure to the air. Most of it is cut out with moil point tools, but some blasting is required, in which case the holes are drilled with a star point drill, tempered for granite. It takes two or three sticks of 60% dynamite to shoot this rock, which is somewhat porous and cannot be handled by either powder or mud-capped dynamite.

The hammer used on this job is of the non-rotating type, so that muck from the shot holes has to be spooned out. A crew of three men is used, composed of two operators and a laborer. The operator not using the hammer clears away the muck while the laborer works on the bank.

This 100-pound hammer has also been used for driving sheet piling and for concrete breaking. It will drive 2 x 6 or 2 x 8 piling easily, and can drive a blow heavy enough to shatter it if an attempt is made to drive into hard clay. One concrete breaking job of an unusual nature occurred out on the edge of the Bad Lands. A bridge under construction was flooded out by a thunder-shower of the type that the Dakota plains are noted for, and an uncompleted pier tipped over. This pier contained some $70 worth of reinforcing steel. The gas hammer was borrowed, the crew hired and transported a round-trip distance of 120 miles, the pier (which contained 6 cu. yds. of concrete) demolished, and the steel salvaged as good as new. The total cost of salvage was $40 for labor, gas, oil and transportation.

It has been learned by experience that storage batteries should be used for ignition, as dry batteries wear out quickly. Storage batteries should not be used when more than about one-half of their charge has been drawn off. Charging is necessary, therefore, after about every 16 hours of operation. About 10 cents worth of current is required to charge a battery.

Killdeer's hammer had run a total of 609 hours to the time this article was written. Operating costs up to that time had been as follows:

Gasoline, 106 gals. @ 21c	$22.26
Oil, 88 qts. @ 31 to 42 cts.	35.50
Repairs (various small parts)	10.88
	$68.64

This is an average cost per hour for operation of 11.3 cents, covering gasoline, oil and repairs.

The Killdeer Sewer Project is under the direction of the following: R. J. Dingle, field engineer, with headquarters at Mandan, N. D.; Ernest B. Hall, area engineer, with headquarters at Hazen, N. D.; and the writer as construction engineer in charge of the work.

A Glossary of Chlorinati

BY ELLIS K. PHELPS

Chlorine is used by more than 75% of the water plants in the United States. Its use has evolved many special terms, together with chemical terms of general application; also diverse special equipment, each of which has received a special designation. All of these—chemical terms, professional designations and trade names—are defined in this glossary, and the various types of equipment described.

Materials and Equipment

1—Chlorine—A heavy greenish yellow liquid or gas; specific gravity (gas) 2.49, liquid 1.44; boiling point—33.6° C (—28.5° F). The chlorine used in sanitary work is compressed to a liquid and shipped in steel cylinders. For this reason it is sold as, and usually referred to as, "liquid" chlorine. It will stay in liquid form as long as the pressure is maintained. When the cylinder valve is opened the pressure is released, which causes the liquid chlorine to "boil" and evaporate at the liquid level, escaping as a gas.

The pressure in the cylinder is dependent on the temperature *in the cylinder,* and on that only. As long as any liquid remains in the cylinder the pressure will remain at a point determined by the *internal* temperature.

The internal temperature in a cylinder will be about the same as the room temperature as long as the cylinder stands idle. As soon as any gas is withdrawn, the "heat of vaporization" chills the liquid chlorine, reducing the pressure gradually at a rate depending on the rate of withdrawal. When chlorine is withdrawn too rapidly from a cylinder, the resultant chill will cause the pressure to drop below that necessary to operate the chlorinator.

Warning: It is dangerous to apply heat to chlorine cylinders. If one cylinder will not supply the demand, connect up two cylinders.

Vapor pressures of chlorine are shown in chart No. 1.

Liquid chlorine is anhydrous (contains no water). Do not confuse with "chlorine-water" solution or with calcium hypochlorite solution.

2—Chlorinator—A device for controlling, measuring, and applying chlorine gas, usually to water or sewage.

3—Hypo-Chlorinator—Strictly speaking, all hypo feeders are chlorinators, but in an effort to eliminate much existing confusion the term "hypo-chlorinator" should be used for all machines feeding hypochlorite solutions or powder. And the term "chlorinator" be applied only to machines using compressed chlorine gas. Therefore, a "hypo-chlorinator" is a machine or device used to feed hypochlorites, either in the form of a water solution or as a powder.

4—Electrolytic Chlorinator—A device which generates chlorine by the electrolytic decomposition of salt in water solution (brine). Chlorine is liberated from the anode as a gas and, rising to the surface, is collected. In some machines it is mixed with water and applied as a chlorine-water solution. In others it is mixed with sodium hydroxide, (liberated in the same cell at the cathode) and applied as a sodium hypochlorite.

The Everson Roto Meter Sterelator

5—Manual Control "Chlorinator" or "Hypo-Chlorinator." A chlorinator or hypo-chlorinator which is designed to maintain a uniform rate of flow of chlorine at whatever rate it is set, regardless of changes in chlorine pressure, pressure at the point of application, or changes in flow of the body being treated.

6—Automatic Chlorinator or Hypo-Chlorinator. A chlorinator or hypo-chlorinator designed to vary the rate of flow of chlorine in proportion to the rate of flow of water or sewage being treated.

7—Semi-Automatic Chlorinator or

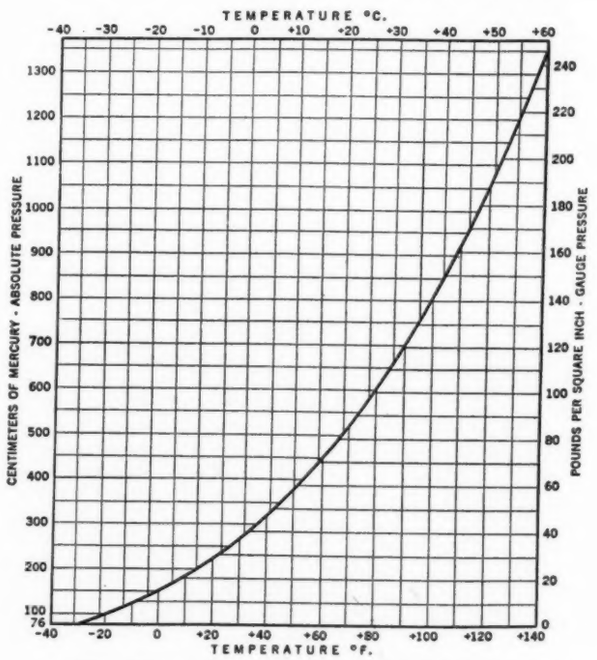
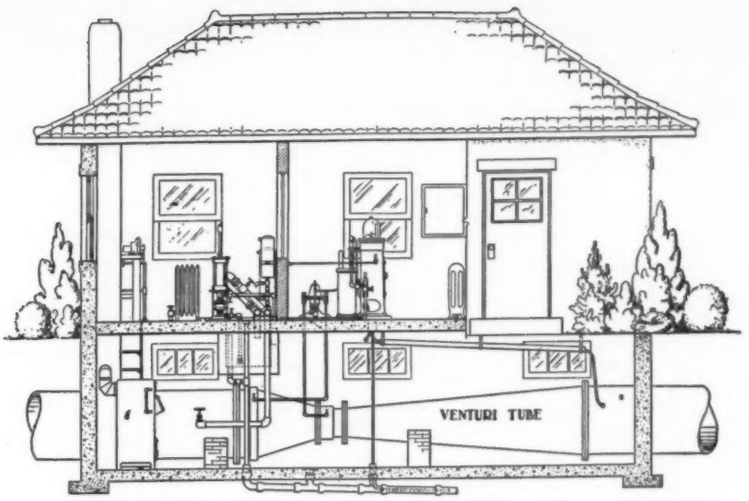
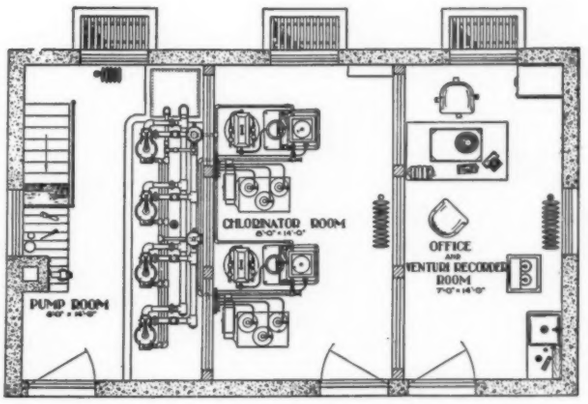


Chart No. 1—Vapor pressure of liquid chlorine

nation Terms



Installation of duplicate vacuum chlorinators with venturi automatic control. Applying chlorine to a gravity main. Wallace & Tiernan



Hypo-Chlorinator. (Sometimes called "Automatic Start and Stop".) A chlorinator designed to start and stop automatically, being either off entirely or feeding at some one rate set manually.

8—Vacuum Chlorinator—A chlorinator in which the gas is metered and controlled under a partial vacuum.

9—Pressure Type Solution Feed—(Semi-Vacuum). A chlorinator in which some of the control functions are carried on under a pressure and some under a partial vacuum.

10—Pressure Type Direct Feed—See "Direct Feed," paragraph 12. All "Direct Feed" chlorinators are pressure type.

11—Solution Feed Chlorinator—(Sometimes Semi-Vacuum). A chlorinator provided with means of dissolving the chlorine in a small stream of water and applying it as a chlorine-water solution. (Do not confuse with hypo-chlorinators feeding hypochlorite solutions.)

12—"Direct Feed" or *"Dry Feed"* Chlorinator—A chlorinator which applies the controlled flow of chlorine to the body of water or sewage directly as a gas, without first dissolving it in a minor flow of water. (Do not confuse with machines which feed dry powder such as chloride of lime or calcium hypochlorite.)

13—Ammoniator—An apparatus similar to a chlorinator but constructed of materials to resist ammonia.

The terms, "Manual Control," "Automatic Control" etc. have the same meaning as when applied to chlorinators.

Most ammoniators are of the "pressure, direct feed" type.

Sometimes aqua-ammonia (a solution of ammonia in water) or ammonium salts are used in place of anhydrous ammonia. These are handled in machines similar to hypo feeders or hypo-chlorinators. Calculations of ammonia doses are made in the same way as for chlorine.

14—"Chlorine Hydrate"—"Chlorine Ice"—A very unstable chemical compound formed when a saturated solution of chlorine-water is lowered below 40° F. Also formed when chilled chlorine gas is admitted to a cool moist atmosphere.

Use of Chlorine

15—"Partial" Chlorination—Chlorinating to satisfy a part of the immediate demand; not enough to produce a residual chlorine. Used chiefly in temporary odor control work in sewage.

16—"Split" Chlorination—Applying chlorine to the same body of water or sewage at different points. For instance, pre- and post-chlorination.

17—"Indirect" Chlorination—Causing chlorine to combine chemically with some other substance, usually iron, in such a way that when applied to the liquid being treated, usually sewage, the activity of the chlorine is transferred to the iron, and subsequent oxidation is performed by the iron, the chlorine being passive or inactive.

18—Chloro-Phenol Tastes—Tastes produced in a water containing even small amounts of phenol when chlorine is applied.

19—Chlorinous Tastes—Tastes produced in a water after chlorination and caused by a combination of the chlorine with organic matter in the water.

20—Chloramination—Treatment with chlorine and ammonia—Chloramine process or ammonia-chlorine process.

The ammonia combines chemically with the chlorine to produce a compound called chloramine. Chloramine is much less active than chlorine alone and does not oxidize organic matter, thus preventing chlorinous tastes.

Operating Terms

21—Parts Per Million. (Abbrv. p.p.m.) The units used in recording chlorine doses and residuals. One pound of chlorine in a million pounds of water would be one part per million (1.0 p.p.m.). As one gallon of water weighs 8.34 lbs., one million gallons would weigh 8,340,000 lbs. and would require 8.34 lbs. of chlorine

to treat it at a rate of 1.0 p.p.m. Do not confuse this abbreviation (p.p.m.) with "pounds per million," which is entirely different. Many operators prefer to base all their chemical doses on lbs. per m. g. and do not use p.p.m. This seems to be a desirable step, as it saves computations and is more intelligible to non-technical operators.

22—Chlorine Dose—The amount of chlorine (usually expressed in p.p.m.) applied is called the "Dose." It can be calculated by the following equation:

$$\frac{1{,}000{,}000}{Q} \times \frac{\text{Cl.}}{8.34} = \text{Dose in p.p.m.}$$

where "Q" is amount of water treated in gallons, and "Cl" represents the weight of the chlorine applied in lbs. Example No. 1—The meter shows that 375,000 gallons of water have been pumped during the day and the platform scales show that three pounds of chlorine have been used in this period. Substitution in the equation we have

$$\frac{1{,}000{,}000}{375{,}000} \times \frac{3}{8.34} = 0.96 \text{ p.p.m.}$$

which is the average "dose" that has been applied.

Example No. 2—2.5 m.g. of sewage passed through the plant during the day and the loss of weight in the chlorine cylinders has been 260 lbs. As above:

$$\frac{1{,}000{,}000}{2{,}500{,}000} \times \frac{260}{8.34} = 12.45 \text{ p.p.m.} = \text{Dose}$$

This same equation can be expressed in several forms, but it is felt that the above form will be more clearly understood by the greatest number of operators.

23—"Residual" Chlorine—As the term implies, the "residual" chlorine is the amount "left over" in the water or sewage at a given time. It is always expressed in p.p.m. The difference between the "dose" and the "residual" represents the amount consumed by the water or sewage in the time interval between the application of the chlorine and the testing of a sample for residual.

Residual chlorine is usually determined by the addition of a reagent, ortho-tolodine, to the sample. If any chlorine is present, the sample will develop a yellow color. The intensity of this color is dependent on the amount of chlorine present. To express this reading numerically, the sample is compared with prepared color standards and the numerical value of the standard color nearest to the sample is the "residual" to be recorded.

If a dose of 0.75 p.p.m. was applied and a residual of 0.2 p.p.m. is obtained, then the amount consumed during the time interval elapsing between the application of the chlorine and the addition of the ortho-tolidine was 0.75 — 0.2 = 0.55 p.p.m. This is usually called the "chlorine demand" of the water; however, it does not mean much unless the dose and elapsed time are stated; which time should be at least 10 minutes where drinking water is involved.

In operating practice, the rate of feed of the chlorinator is adjusted until a suitable residual is obtained, then the dose is calculated. The residual is the *all-important determinant* as to how much to apply.

The necessary residual and the time interval involved in testing vary greatly with local conditions. Where the public health is concerned, these two points should always be determined by responsible health officials.

To be concluded next month with descriptions of chlorinating and ammoniating equipment.

Four Years of State Highway Construction

DURING the four years, 1934-1937, the total mileage of roads constructed on state highway systems totaled 74,255. As classified by the U. S. Bureau of Public Roads, these were distributed as follows: Sand-clay treated, 5,362; Gravel treated, 18,650; Macadam treated, 3,150; Low-cost bituminous mix, 26,601; Bituminous macadam, 2,617; Bituminous concrete, 5,213; Portland cement concrete, 12,430; Brick and brick block, 232.

By states, we find sand-clay used in 14 states, 2 of them with less than 10 miles. Gravel was laid by 36 states, 2 with less than 10 miles. Macadam by 15 states, 3 less than 10 miles. Low-cost bituminous mix by 42 states, 3 less than 10 miles. Bituminous macadam by 31 states, 7 less than 10 miles. Bituminous concrete by 44 states, 11 less than 10 miles. Portland cement concrete by 47 states, 2 less than 10 miles. Brick and brick block by 20 states, 17 less than 10 miles.

Only two of the states—Geogia and Pennsylvania—laid some of all 8 classes. At the other extreme, Wyoming laid only two—sand-clay and low-cost bituminous mix. Seven types were laid by 6 states; 6 types by 13 states; 5 types by 12 states; 4 types by 9 states; and 3 types by 5 states.

Nine of the states laid none of the treated types. Wyoming was the only state that did not lay some portland cement concrete. Louisiana, South Carolina, and Wyoming were the only ones which did not lay some bituminous concrete. The largest amount of sand-clay road was laid by Kansas, with California a close second. Pennsylvania's mileage of gravel treated roads—3249—was greater than that by any other state of any type of road, with Wisconsin second and Texas a close third. Virginia laid the most macadam treated road, with Oregon a close second. Pennsylvania led in the mileage of low-cost bituminous mix, with Wyoming a close second. In the bituminous macadam class, Pennsylvania led, with Oregon second. In bituminous concrete, Ohio led with Pennsylvania a close second. In portland cement concrete, Illinois led, with Texas second. In brick and brick block, Ohio led, and that state, Indiana and Illinois were the only ones laying more than 8 miles. In total construction, Pennsylvania led with 8,413 miles; followed by Wisconsin, 4,650; Texas, 4,323; California, 4,278; and seven between two and four thousand, and fourteen between one and two thousand. New Jersey was at the bottom of the list with 186 miles and Massachusetts next with 276 miles.

Some of the states distributed their mileage more or less uniformly among several types, but in 27 states more than 50% of the construction was confined to one type. Arranged by preferred types, these were as follows:

Sand-clay—South Carolina. *Gravel*—Arizona, Colorado, Maine, Minnesota, New Hampshire. *Macadam*—Oregon, Virginia. *Low-cost bituminous mix*—Arkansas, Idaho, Missouri, Montana, Nebraska, Nevada, New Mexico, North Dakota, South Dakota, Utah, Vermont, Washington, Wyoming. *Bituminous macadam*—Massachusetts. *Portland cement concrete*—Illinois, Louisiana, Michigan, Mississippi, New Jersey. This shows 13 states listed under low-cost bituminous mix, 5 under portland cement concrete, 5 under gravel, 2 under macadam, and 1 each under sand-clay and bituminous macadam.

What High-Rate Trickling Filters ARE and DO

Trickling filters have been used for years, but the construction cost is great. Now we are told their capacity can be increased five to ten times. In this article the theory on which this claim is based is explained, the construction and operating features are described, and the opinions of several recognized experts are given.

FOR some time the idea of operating trickling filters at a rate much higher than the 2 or 3 million gallons per acre per day which for many years has been standard practice has been the subject of intensive study and investigation in this country and to a less degree in England, Germany, Holland and some other countries. As a result of these, certain conclusions have been reached which are now pretty generally accepted in whole or in part; to the extent that several plants intended to operate as high-rate sprinkling filters, treating 10 to 20 mgad, recently have been or are now being constructed, and the boards of health of at least two states (Wisconsin and Minnesota) have adopted tentative standards for the design of such filters.

One of the most enthusiastic investigators and proponents of high-rate filtration is Dr. H. O. Halvorson, of the University of Minnesota. Among other investigators are Dr. Max Levine, Dr. F. W. Mohlman, Harry M. Jenks, Karl Imhoff (in Germany), and G. P. Edwards and G. O. Adams of the Lawrence Experiment Station. Recently up-to-date expositions of the conclusions of the three last named have been published in the Sewage Works Journal, and those of Halvorson in the Official Bulletin of the North Dakota Water and Sewage Works Conference. Based chiefly on these, we have prepared the following statement of the principles involved and the conclusions reached as to the possibility and methods of greatly increasing the capacity of sprinkling filters.

Biological Principles

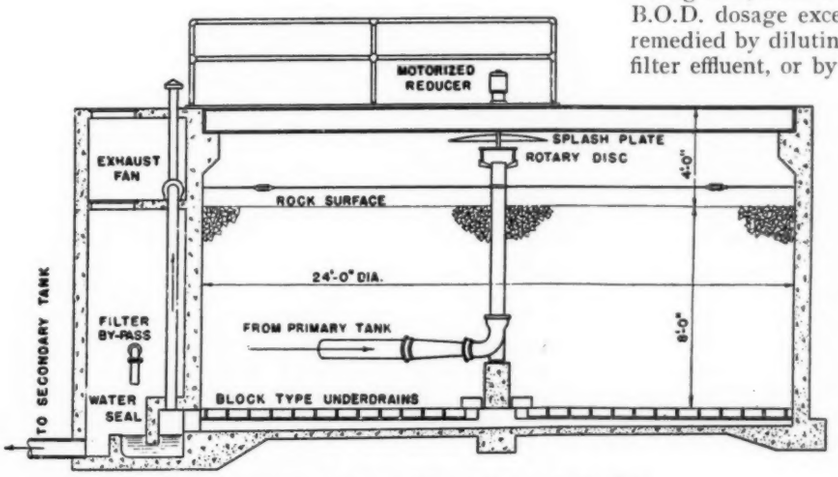
Bacteria function most actively when fed continuously, and there is no biological foundation for rest periods in filter operation if the load applied does not exceed the nitrifying capacity.

The nitrifying bacteria attach themselves to the filter media by means of stalks, forming a microscopic forest through which the liquid percolates and by which the suspended matter is caught and a portion of the dissolved organic matter absorbed to become part of the microbial protoplasm. When the growth becomes so dense that no oxygen reaches the part attached to the filter medium, anaerobic bacteria destroy the stalks and the masses break loose—the filter "unloads." Then the cycle is repeated.

In the high-rate filter the collection of suspended matter is never allowed to reach the putrefying and unloading state but is carried away in the effluent continuously and only thin films grow on the stones. The filter therefore does not stabilize the sludge in its interstices, acting only as an oxidizing filter and not as a digestion tank, and all the oxygen in its interstices is available for vitrification. This, with uniform distribution and abundant ventilation, permitting all parts of the bed to operate at their maximum capacities, accounts for the high rate possible.

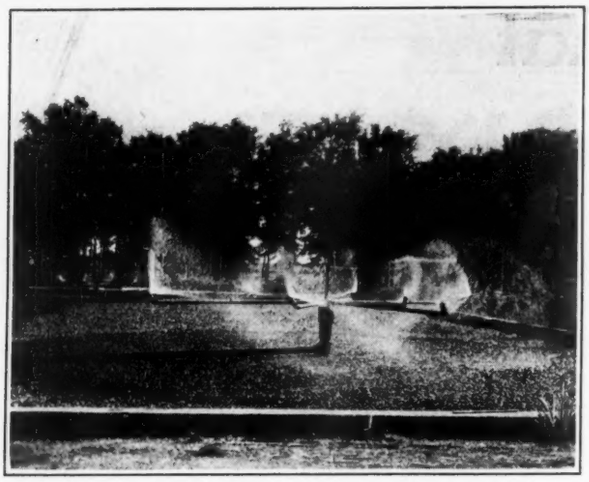
But to so act, there must be sufficient volume and velocity of flow over all the media surfaces to insure continuous removal of the solids; that is, a minimum as well as a maximum rate of dosage must be observed, and this not only for the filter as a whole but for every square foot of it.

The maximum dose is fixed by the number of pounds of B.O.D. per 24 hrs. that the filter can handle, and this to a large degree by the total surface area of the filter media and the oxygen available to it. If the sewage is so strong that, even with the minimum scouring dose, the B.O.D. dosage exceeds the filter capacity, this can be remedied by diluting the applied sewage with water or filter effluent, or by making the filter deeper and thus increasing its capacity. The former plan seems to be favored in this country, the latter in Europe. If the volume of flow falls below the minimum at night or other periods of low flow, Halvorson recommends that filter effluent be pumped back to the influent to maintain the minimum. (This can be done automatically by using a pump controlled by the rate of flow to the filter.)



Cross-section of high-rate "Aero" filter at Bedford, Ia.

Experience of various investigators seems to indicate that the rate should be not less than 10 nor more than 30 mgad. Halvor-



Experimental distributor at Marshfield, Wis. using glazed pottery nozzles for giving a uniform, rain-like distribution of sewage

son finds efficiency fairly constant with his filters between 10 and 26 mgad, but decreasing rapidly between 26 and 30, and this seems to be confirmed by Mohlman and Imhoff.

Halvorson finds that, dosing a filter at 20 mgad, if the sewage has a 5-day B.O.D. exceeding 700 ppm, acidity develops in the filter flora and the efficiency decreases. Even with a sewage B.O.D. of 700, that of the effluent will be high; the *percentage* purification remains about constant, whatever the strength of the raw sewage. If a comparatively stable effluent is essential, the B.O.D. of the sewage should not exceed 200. Imhoff would express the rate of loading in persons, or in pounds of B.O.D. per 24 hours, per cubic unit of filter; suggesting 720 gm. of 5-day B.O.D. per cubic meter per 24 hours. The Wisconsin and Minnesota state boards of health limit the filter loading to "one pound of 5-day B.O.D. per square foot of filter per 24 hours based on an 8-foot depth."

Construction of Filters

Since access of abundant air to all parts of the filter is necessary, to insure this and prevent clogging it seems necessary to use filter stone of not less than 1½ in. diameter—2 in. is better—but not larger than 3 in. Some success has been had with a tile medium which provides a series of 1 in. tubes extending from top to bottom of the filter, providing large ventilating voids and large total surface area and facilitating unloading.

With free circulation of air between bed and underdrain, adequate ventilation of the bed is provided naturally when the difference betwen the temperatures of the sewage and the outside air exceeds about 7°; but if it is less than this for longer than a very short period there is need for artificial ventilation; the higher the B.O.D. of the sewage the greater the need. Imhoff says that if there is at least a 4 in. air space under the filter and the side walls of the filter are tight, artificial aeration is unnecessary unless the depth exceeds about 8 ft., although it is safer to place the limit at 6½ ft. Halvorson says the underdrains should be large enough to permit the free flow of air, never being more than ⅓ full of liquid.

There does not appear to have been much study given in this country to the effect of depth on high-rate filters. Halvorson makes his 6 to 8 ft. deep. Wisconsin and Minnesota base their dosage requirements on 8 ft. depth. The filters used in the studies at the Lawrence Experiment Station were 10 ft. deep. Imhoff says that the stronger the sewage the deeper must be the filter, to keep within the necessary rate of B.O.D. per unit volume of filter medium; suggesting two filters in series with a combined depth equal to that necessary, if one filter would be undesirably deep. With strong European sewages, depth of 10, 12 and even 19.7 ft. are used.

Uniform distribution is considered very important. It is even more true of large filter stone than of the smaller sizes often used in low-rate filters, that there is little or no horizontal spreading of sewage as it descends through the filter, and the entire depth of a section of filter is effective only in proportion to the dose received by its top area. In addition to this reason, if the rate on any small area for any considerable time falls below about 10 mgad, the part of the filter under that area is likely to clog. Halvorson reports excellent results with rotary distributors provided with spraying nozzles; or, if the bed is not more than 30 ft. diameter, with a disc distributor which throws the liquid with centrifugal force; the aim being to obtain a rain-like spray uniformly distributed. (It would seem desirable to eliminate the effect of wind on such spray by enclosing the filter, or at least surrounding it with dense shrubbery.)

As with low-rate filters, primary settling is considered necessary; for 1.5 hrs. by Imhoff, while 2 hrs. based on a maximum 18 hr. flow is required by the states named. Final settling also is necessary. High-rate filters produce a larger volume of settleable solids per volume of sewage treated than do low-rate ones, and it is more putrescible and settles more slowly in the final settling tank; and at least 2 hours' detention in such tanks and sludge removal mechanism are considered essential. Some pump this sludge to the primary settling tank, others directly to a sludge digestion tank. In general it is similar to activated sludge and can be treated accordingly.

Results Obtained

The final effluent appears to be nearly or quite as good as from a low-rate filter, a B.O.D. removal of 85 to 90% being reported from several plants, but as low as 55 to 60% at Chicago. The effluent from the filter itself is not generally so clear as from a low-rate filter between unloading periods, because the high-rate is unloading continuously and the solids removed are undigested and in smaller flocs scattered throughout the liquid.

Continuous spraying of the bed prevents psychoda flies from emerging into the atmosphere, although the larvae are found in the sludge. It also prevents ice formation. Also, the common trickling filter odor seems to be absent.

Much less favorable conclusions are entertained by Edwards and Adams, based on experiments with small filters 20" in diameter at the Lawrence Experiment Station, Massachusetts, begun in 1935. Three filters 10 ft. deep, using respectively ¾-1½ in. and 1½-2½ in. stone and preformed tile, were operated at 20 mgad with a filter loading of 5,200 lb. of B.O.D. per acre-foot per day. These filters with final settling removed from 2,360 to 3,180 lb. of B.O.D. This 45 to 60% was the most easily oxidizable material, but the 40 to 55% left was still putrescible although more stable. The effluents were "turbid and unattractive in appearance and far inferior to the clear effluent obtained from filters operated at the usual rate." The residual B.O.D. was more than 120 ppm—"much too high for a satisfactory biological plant effluent." It will be noticed that the stone used in these filters was smaller than that recommended above; the sewage was applied by means of a tipping trough discharging onto a perforated pan, which possibly did not give a uniform rain-like spray; moreover, the settled sewage applied contained about 312 ppm. of B.O.D., which is very much higher than the limit set by the state boards of health.

The Editor's Page

Sanitation Pays on Construction Work

In the construction of the All-American canal and the Imperial dam in Imperial County, Calif., there were 10,335,351 man-hours of employment, covering a period of three and a half years. No cases of typhoid or paratyphoid fever or small-pox occurred, and only two cases of quarantinable disease. No major outbreaks of any disease occurred, though, at the peak of the work, some 4,000 persons were employed.

This is a record to be proud of. Our congratulations to Dr. Warren F. Fox, health officer of Imperial County, who did not wait for trouble to come, but, through preventive sanitation, made it quite certain that trouble could not come. This fine record, according to Dr. Fox, was due to cooperation with the contractors on the job in the provision of: Pure water supply and bathing facilities; proper disposal of sewage and garbage; sanitary housing; immunization against certain diseases; protection of foods; sterilization of eating and drinking utensils; fly control; and adequate public health nursing services.

Looking at the items listed above, one realizes the important part that the sanitary engineer can and does play in sanitation and the prevention of disease.

State Boards of Health Recognize High-Rate Filtration

Criticism has been directed at several of the State Boards of Health, whose approval is necessary for the construction of a sewage treatment plant by any municipality of their state, as obstructing progress by refusing such approval for any but old and tried methods—especially for any patented process. In our February issue we gave the statement of Minnesota's state board outlining their policy in this matter, which seems to us an excellent one. This policy is "to encourage the development of new processes which show promise of success." But approval of a new process is conditioned on it having "been thoroughly tested and found satisfactory in a full-scale plant"; however, it will not interfere if a municipality is willing to assume full responsibility for a demonstration plant and adequate guarantees are made that, if not satisfactory, it will be made so.

Among the recent developments has been the high-rate operation of sprinkling filters. Apparently this has demonstrated its value, for the state health board of Minnesota, with that of Wisconsin cooperating, has prepared tentative requirements for the installation of such a process. These call for 2-hr. detention in a primary settling tank (the alternative of fine screens is being studied); a medium of 2" to 3" crushed rock or gravel, or equivalent; an underdrainage system which, at maximum rate of flow, will not be filled to more than 1/3 its capacity and will then provide a total unsubmerged inlet area equal to at least 5% of the filter surface; controlled recirculation so that the 5-day B.O.D. can be held at 200 ppm or less; a final settling tank giving a 2-hr. detention period based on maximum flow; uniform distribution over the filter; and filter loading not to exceed one pound of 5-day B.O.D. per sq. ft. of filter per 24 hrs., based on 8 ft. depth, the maximum rate not to exceed 26 mgad in any case.

Election Changes and Technical Personnel

The November elections brought many changes in political control, and we fear there will be a tendency to make changes in technical personnel in our counties, cities and states in order to pay off the deserving supporters. The minor (?) matters of ability and faithful service do not mean much to some political types, we regret to say.

There are certain key posts in every city, county and state which should be filled only by those having the necessary experience and training. The city or county engineer who is not qualified can cost the taxpayers a lot of money by his mistakes of commission and omission. The waterworks superintendent who does not know how to operate the community water system also can waste a lot of money; and he can moreover, through ignorance of proper operation, permit unsafe water to reach the consumers.

There are plenty of other places, besides these two, where changes for political reasons might easily endanger the health, comfort or pocket books of citizens and tax payers. If changes are made for any reason, appointees ought in every case to be given the most rigid scrutiny to be sure that the community will not suffer from their lack of experience or training.

Data Wanted from Sewage Plants

Operators and supervisors of sewage treatment plants can help materially in the progress of certain sewage treatment investigations that are now going on. Primarily these have to do with chemical coagulation, and data from a number of plants are desired.

First, we would like to have reports on the alkalinity of the sewage. If possible, these should be taken every hour or every two hours on any Monday and also on any other day of the week. Monday sewage is ordinarily very strong, and the alkalinity will be higher than on other days. If hourly or every other hour samples are available, please note the hours; if you have time for only one Monday sample, make that at the time of the forenoon maximum flow. Other alkalinity samples should be taken, also, for purposes of comparison, at about the same hour on some other day.

We would also like to have the result of a test on the alkalinity of your digestion tank supernatant. It does not matter when this is taken.

If possible, pH readings should accompany all the alkalinity reports. This is not so important, for the present investigation, as the alkalinity readings.

We will greatly appreciate having those of our readers who are able to make these tests, or already have such data on hand, send the results to us.

Building a Cinder Running T

City and county engineers are called upon to design and construct all kinds of public projects. One of our readers, a city engineer, has asked us how to build a running track; others are asked to engineer athletic fields for schools. These will find helpful suggestions in this article.

BUILDING running tracks, which are used in athletic grounds of colleges, municipal play grounds and elsewhere, would seem to be an engineer's job, but there seems to be little information on the subject for them to go by. At least, that was the conclusion of John J. Mundinger, supervising engineer for Louisiana State University, when he was asked to design a track for the University. The head coach and athletic director advised as to length, width and other features of the layout. Good drainage was obtained by following accepted engineering practice with tile drainage and run-off for storm water. A bed of well graded cinders sufficiently deep and thoroughly compacted gave a firm but resilient footing. How to obtain a compacted surface, sufficiently hard to be fast but not so hard as to cause injury, was not so evident.

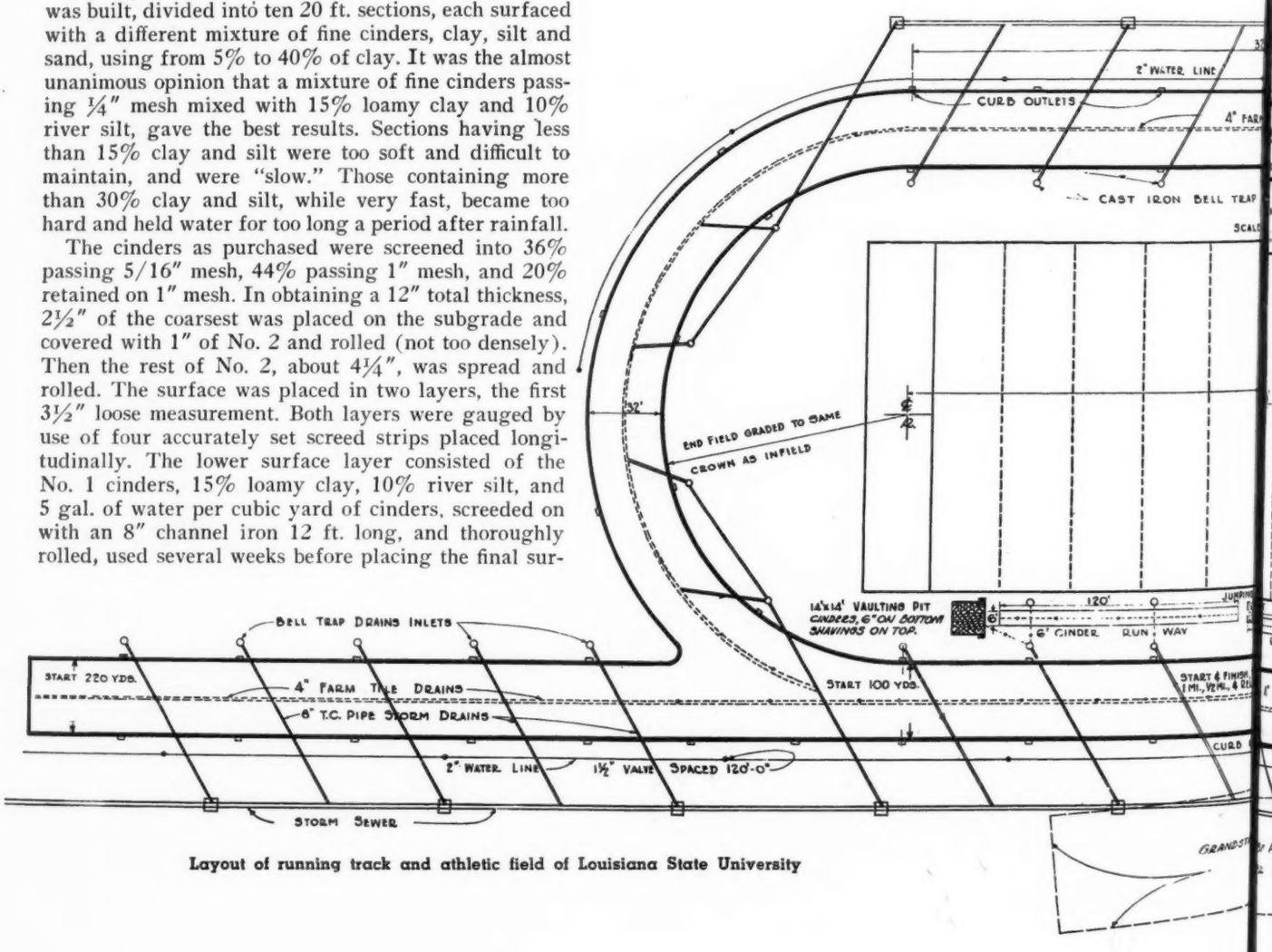
An experimental track 6 ft. wide and 200 ft. long was built, divided into ten 20 ft. sections, each surfaced with a different mixture of fine cinders, clay, silt and sand, using from 5% to 40% of clay. It was the almost unanimous opinion that a mixture of fine cinders passing ¼" mesh mixed with 15% loamy clay and 10% river silt, gave the best results. Sections having less than 15% clay and silt were too soft and difficult to maintain, and were "slow." Those containing more than 30% clay and silt, while very fast, became too hard and held water for too long a period after rainfall.

The cinders as purchased were screened into 36% passing 5/16" mesh, 44% passing 1" mesh, and 20% retained on 1" mesh. In obtaining a 12" total thickness, 2½" of the coarsest was placed on the subgrade and covered with 1" of No. 2 and rolled (not too densely). Then the rest of No. 2, about 4¼", was spread and rolled. The surface was placed in two layers, the first 3½" loose measurement. Both layers were gauged by use of four accurately set screed strips placed longitudinally. The lower surface layer consisted of the No. 1 cinders, 15% loamy clay, 10% river silt, and 5 gal. of water per cubic yard of cinders, screeded on with an 8" channel iron 12 ft. long, and thoroughly rolled, used several weeks before placing the final surface, being wetted, broomed and rolled at frequent intervals meantime. The final course was similar to that just described except that the amounts of clay and silt were reduced 50% and the screed strips were only 1" thick, the course below having first been scarified to a depth of at least 1" and sprinkled well with water.

For other geographical locations, allow for climatic differences. Where deep freezing occurs, make the cinder base thicker. Where excessive rainfall is prevalent, additional drainage facilities should be provided. (Rainfall at Baton Rouge averages 60" a year, 4" to 6" sometimes falls during one 24 hr. period.)

Layout of Track

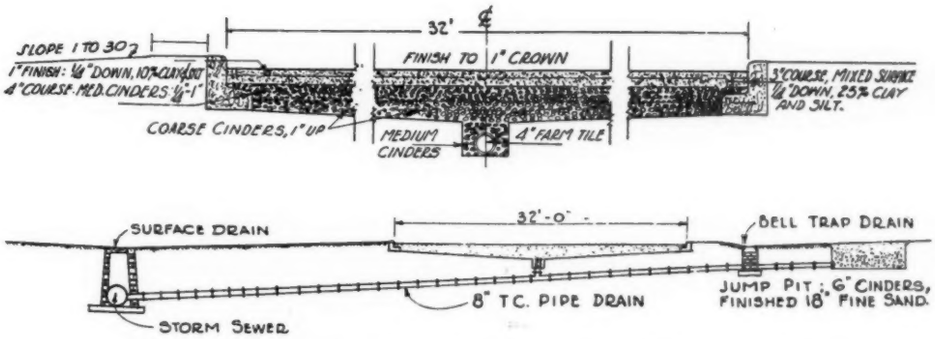
The L. S. U. track consists of a quarter-mile oval, with chutes 32 ft. wide at diagonally opposite ends so



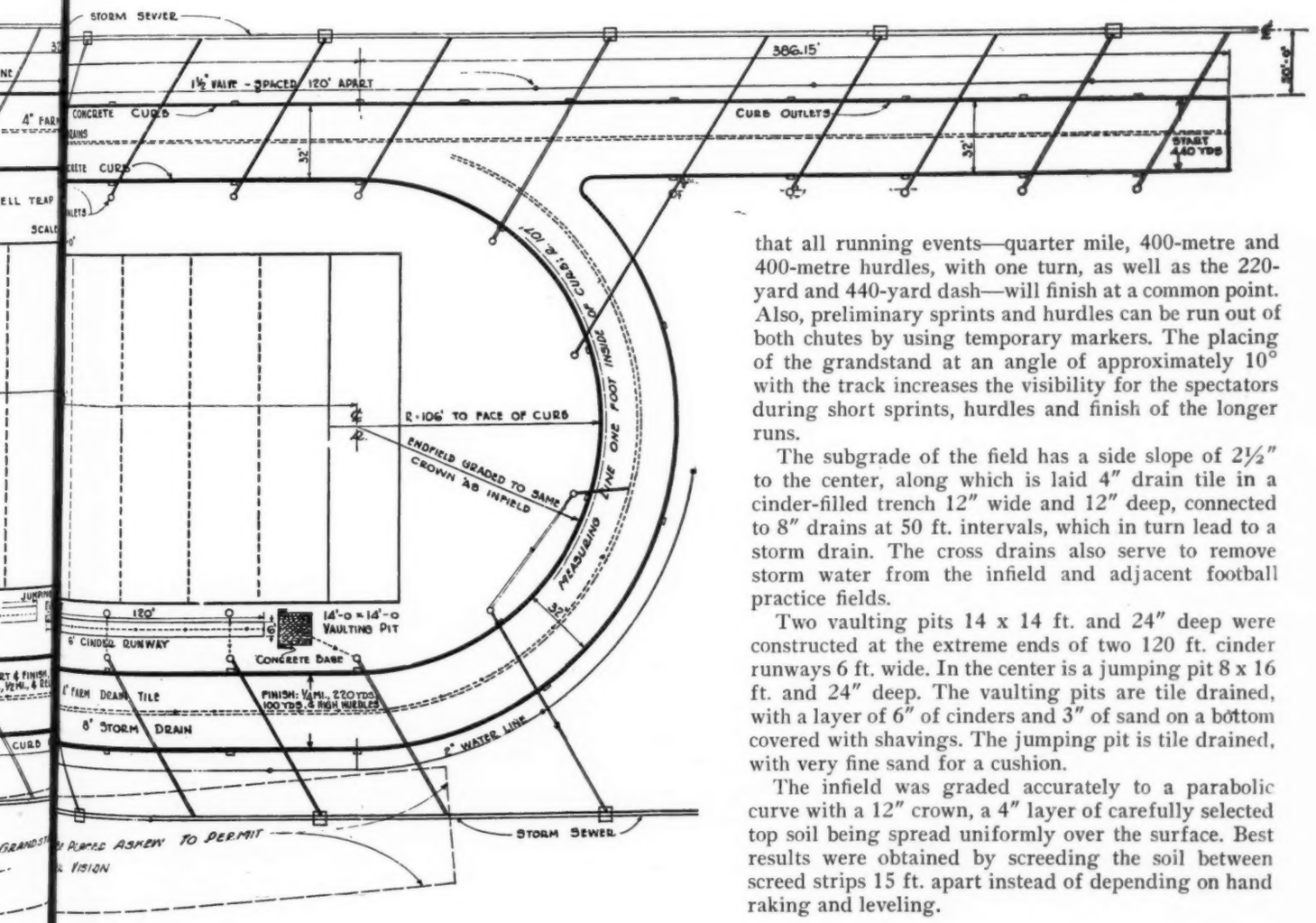
Layout of running track and athletic field of Louisiana State University

ngTrack

As reported by
JOHN J. MUNDINGER,
Supervising Engineer for Louisiana State University



Top—Section through cinder running track. Bottom—Section through jumping pit track



that all running events—quarter mile, 400-metre and 400-metre hurdles, with one turn, as well as the 220-yard and 440-yard dash—will finish at a common point. Also, preliminary sprints and hurdles can be run out of both chutes by using temporary markers. The placing of the grandstand at an angle of approximately 10° with the track increases the visibility for the spectators during short sprints, hurdles and finish of the longer runs.

The subgrade of the field has a side slope of 2½" to the center, along which is laid 4" drain tile in a cinder-filled trench 12" wide and 12" deep, connected to 8" drains at 50 ft. intervals, which in turn lead to a storm drain. The cross drains also serve to remove storm water from the infield and adjacent football practice fields.

Two vaulting pits 14 x 14 ft. and 24" deep were constructed at the extreme ends of two 120 ft. cinder runways 6 ft. wide. In the center is a jumping pit 8 x 16 ft. and 24" deep. The vaulting pits are tile drained, with a layer of 6" of cinders and 3" of sand on a bottom covered with shavings. The jumping pit is tile drained, with very fine sand for a cushion.

The infield was graded accurately to a parabolic curve with a 12" crown, a 4" layer of carefully selected top soil being spread uniformly over the surface. Best results were obtained by screeding the soil between screed strips 15 ft. apart instead of depending on hand raking and leveling.

Increasing Canton's Ground Water Supply With a New Well

By C. S. BOLENDER
Superintendent, Division of Water and Garbage

I WAS born and raised in Canton, O., and, as far back as I can remember, there was always a water shortage just around the corner. It semed to me, before I became Superintendent, that Canton would surely go to the bow-wows unless new sources of supply were obtained. I can remember twenty-five years ago the Mayor appointed a water commission of big fellows in town and they finally succeeded in spending a million or more of the taxpayer's money which was forever to relieve the said taxpayers of future water worries. The gentlemen were the leading citizens of Canton but were not water engineers.

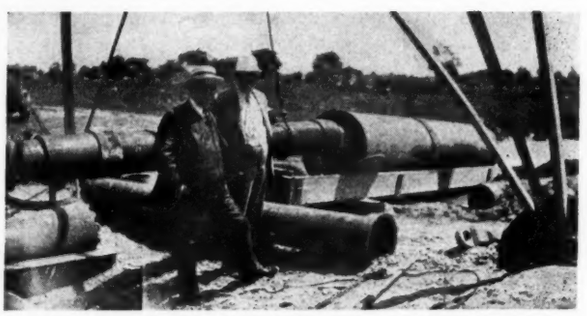
The original source of Canton's water supply was what was known as the 9th street field, situated in almost the center of Canton. In 1918 the Commission recommended buying another field, known as the Harrisburg Road field, which the city did. The original field was abandoned in favor of this new field.

Once again, in 1924, the situation became acute. This time it was decided the Harrisburg field supply was limited and it was necessary to buy a new water field. This new field is located about six miles northwest of the city and, when developed, was to banish for all time worries of water shortage for the people of Canton. To date this field has never been used by the city but has cost the taxpayers a pretty penny. They struggled along with the Harrisburg field for years, always crying a shortage of water but never developing same.

But here the picture changed. Jim Seccombe was elected Mayor and took office January 1, 1936. One of his first acts was to appoint a Water Commission composed of engineers. They went to work immediately and without spending much money found by drilling many test holes that the Harrisburg Road field had an almost inexhaustable supply of water. They then laid out a two-year development program which included new distribution facilities, new wells, new pumps on old wells, and revamping of the electrical equipment.

This program is now practically completed, with the result that Canton has plenty of water for all purposes. Our daily consumption averaged 12,680,000 gallons per day in 1937. The total capacity of the pumps was then approximately 16,000,000 gallons per day, but since completing the new wells we have increased the pumping capacity to 25,000,000.

The first 30-inch well was drilled in 1937; the rock formation on this hole was 210 ft. with a static level of 28 ft. We drilled this well to a depth of 161 ft. using 130 ft. of bar type screen, 31 ft. of blank casing and 50 ft. of 54-inch outside casing. We used a Wintroath 3-stage pump with a 75 hp motor. This well was placed in operation July 26, 1937, and has produced 6,000,000 gallons per day every day since that time, with a drawdown of 8 ft. The Commission decided to change the specifications slightly on the next well and used 150 ft. of bar-type screen, 50 ft. of blank casing and 50 ft. of 54-inch outside casing, making the total depth of this latest well 200 ft. The same type of pump was used as on well No. 1. This well has gone into production on a 6,000,000 gallon per day basis and the draw-down is the same as on well No. 1, although the wells are in widely separated areas. We do not use treatment of any kind.



Testing a new well. The author in a dark suit.

Without the valuable advice of the Water Commission, who are all trained in this field, the Department would no doubt be floundering around without a definite program and making a hit or miss proposition as in years gone by; and, by the way, this Commission serves without pay. They have given of their time willingly, attending many meetings, with the only thought in mind of making the Water Department as efficient as possible.

Canton, with a population of 120,000, has one of the cheapest water rates in the country. We charge $2.50 minimum per quarter for 2000 cubic fet of water. We have 30,000 customers and the avearge per capita rate of consumption was 92 gallons per day in 1937.

The point I want to stress is, that with the expenditure of a small amount of money, Canton now has plenty of water for all purposes, and that this is due to the drilling of the large wells and the carrying out of other improvements on the recommendations of the Water Commission.

For more than 25 years an Ohio city kept one jump ahead of a water famine. And the money it spent doing so was aplenty. Its water commission was composed of business men who had abundance of good intentions but no engineering knowledge. Then a commission composed of engineers was appointed, and in a few months they had doubled the supply, and at such low cost that the city's water rates are among the lowest in the country.

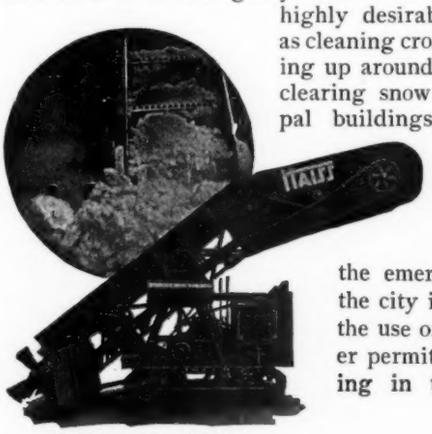
A Barber-Greene snow loader at work.

The Economics of Snow Removal From City Streets

WHEN a snow storm comes, there is never too much labor and equipment available to handle it—usually there isn't enough, if the snowfall is more than a few inches deep. Therefore, *time-saving* machinery is important. The executive, highway and financial departments of every city are interested in prompt, efficient and economic removal of snow. This article gives some information regarding the advantages of snow loaders for city snow removal.

Very few cities, towns or villages have enough trucks of their own to haul away the snow that falls on their streets, especially if time-consuming hand loading is employed. Where this is the case, either trucks must be rented, which means real money, or the streets remain blocked for several days or weeks, with loss to almost every business in the community; while thaws or rains, followed by freezes, may double the cost of removal. If the former alternative is adopted, anything that cuts down loading time reduces cost of truck hire as well as of loading labor.

The use of snow loaders cuts down loading time and practically eliminates loading labor; but this only means that such labor is released for use elsewhere; for, as stated above, there is use for all the labor available in a snow emergency. All of it can be used in highly desirable work, such as cleaning cross-walks, opening up around fire hydrants, clearing snow from municipal buildings, and taking care of necessities, such as funerals, etc. But even so, the emergency cost to the city is reduced, for the use of a snow loader permits enough saving in truck hire to more than pay for itself, unless the mileage to be cleaned is small.



A Haiss snow loader

Trucks cost from $1.25 per hour to $2.50 per hour for rental. The time lost while the trucks are being loaded by hand, at such rates per hour, runs into important money. If trucks are hired at so much per yard of snow, the owner simply makes the rate per yard high enough to compensate for standing-still time.

A fair average for hand loading trucks is said to be one yard every five minutes, with the average gang of shovelers. Because sideboards to increase the amount of snow the truck can carry would require that the snow be pitched too high, a 4-yard truck will handle only 4 yards of snow. Therefore, it takes about 20 minutes for a gang to load a 4-yard truck. On the basis of $2.25 per hour for the truck, it costs the city 75 cents for the truck to stand idle 20 minutes; or about 19c a cubic yard of snow removal.

When a snow loader is used, the truck can be equipped with side boards that will enable it to carry 8 yards of snow. Most snow loaders have a capacity of about 10 yards a minute, but traffic delays, etc., will cut down the average loading time, and usually the trucks will be loaded at the rate of one each 2 to 3 minutes. If it takes 10 minutes for a truck to haul a load away, dump it and return, approximately 5 trucks will service one loader (although 6 probably would be true economy). If the loader handles 3 yards a minute or 180 an hour, each truck hauls 30 yds. an hour—and the truck hire, at $2.25 an hour, costs 7.5 cts. a yard.

With hand loading at 4 yds. in 20 minutes and 10 minutes for hauling, a truck removes 8 yds. an hour, and truck hire costs 28 cts. a yard. This shows a saving in truck hire of 20.5 cts. for each cubic yard of snow removed.

A snow loader costs around $5,000 and has an average useful life of 10 years if well kept up. The annual cost for dead storage ($150), depreciation and interest ($625) and annual overhaul ($50) is estimated at $825 per year. The cost of operation per 8-hour shift

will be about as follows: Operator, $12.00; oil, grease and 25 gallons of gasoline, $5.25; and repairs estimated at not more than $4, total $21.25.

Estimating operating costs at $21.25 per 8-hr. shift gives a cost of about 1.5 cts. per yard; and deducting this from the 20.5 cts. savings per yard leaves 19 cts. per yard to cover fixed charges. If these are $825 a year, then the loader will pay for itself if it loads 4,342 yards of snow a year. (If trucks are hired at $1.25 an hour the amount to be handled would be 7,816 yds.)

The average street will have close to 1½ yards of snow per linear foot of street per foot of snowfall. Therefore the removal of a total winter's snowfall of 12 inches over 0.8 mile of street would pay for the loader out of truck hire saving, without considering the other advantages. If the city owns some trucks, this can be allowed for, remembering to consider cost of driver and the depreciation of the truck.

This, it will be remembered, allows nothing for saving in labor. But one loader will do the work of 80 men loading—an additional saving of, say, 25 to 50 cts. a yard.

There are also less apparent benefits and savings which may be difficult to put a money value on. Speed in getting the snow off the streets is important to retail business. Speed is also important in getting rid of the snow before a change in temperature makes it two or three times as difficult and costly to remove. Street maintenance is reduced by cleaning streets from curb to curb so that traffic is not concentrated and ruts do not form. City trucks called to snow service usually have other and important duties to perform—garbage and refuse removal, for instance.

Four-State Agreement on Delaware River Pollution

(Continued from page 10)

ment to restore the dissolved oxygen content of the river water in this zone to at least 50% saturation. To accomplish this, it may be necessary in the case of certain wastes, to obtain reductions greater than those required under this item)." (4) If the effluent is discharged within two miles of a public water works intake or within prejudicial influence thereof, it shall at all times be effectively treated with a germicide. (5) As in Zone 1, except that uses to be protected are public water supplies, industrial and "other purposes, and fish life." (6) Shall be free of substances capable of producing offensive tastes and odors in public water supplies.

Zone 4. (1) as in Zone 1. (2) as in Zone 3. (3) Reduction of 55% of total suspended solids, and any further treatment needed to prevent a nuisance. (4) If discharged within prejudicial influence of a public water work intake, or recreational areas or shell fish grounds, effluent shall be effectively treated with a germicide; but only from May 15th to Oct. 15th in the case of recreational area influence. (5) As in Zone 1, except that uses to be protected are public water supplies, commercial fishing, shell fish culture, recreational, industrial or other purposes. (6) as in Zone 3.

Intrastate tributaries of the Delaware river shall, at a point immediately above their confluence with the river, be in a condition at least equal to the clean and sanitary condition of the river immediately above the confluence.

If it shall be found that the maintaining of the above minimum requirements does not result in the objective sought, it may be necessary to impose additional requirements, especially in Zones 2 and 3.

The sewage treatments necessary for the larger municipalities to meet these requirements are given as follows: Zone 1—Complete treatment for Hancock and Port Jervis, N. Y.; Easton Pa., and Phillipsburg, N. J. Zone 2—Complete treatment for Trenton, Florence, Burlington, Beverly and Riverside, N. J.; and Bristol, Pa. Zone 3—Primary treatment for Riverton, Camden, and Gloucester, N. J.; Philadelphia, Chester, Central and Lower Delaware County communities, Pa. Zone 4—Primary treatment for Salem, N. J.; Wilmington, New Castle, Bellefont and Delaware City, Del. None of the above now have complete treatment. Primary treatment is effected at Easton, Phillipsburg, all those in Zone 2, about 20% of the sewage of Philadelphia and Camden. There is no treatment at any of the others.

Boston Keeps 700 Miles of Streets Free From Snow

(Continued from page 12)

Inspectors and Dumping Inspectors will also be furnished with other necessary equipment to carry out this system (forms, plates, etc.). The plate holders will be furnished the District Engineer with the top metal section already in place with the District Number and Vehicle Number marked thereon.

As each truck reports for work, it will go to the measuring station which covers that particular district in which the truck is working during the storm. The District Engineer will then measure the truck and compute the cubic yard content to the nearest tenth of a cubic yard. The Engineer will then emboss on the bottom sectional plate the vehicle registration number and the cubic yard capacity. The Engineer will then make out the Capacity Certificate in triplicate. The plate holder with the top and bottom sectional plates inserted will then be given to the driver of the truck with a copy of the Capacity Certificate. The Engineer will retain the second copy of the Capacity Certificate and will send the third copy to the office for the files.

The Contractor's truck will proceed to the street on which it is to work and will report to the Loading Inspector. When the truck is loaded, the Inspector will take the plate holder from the driver, remove a numbered load plate from his ring of plates, and insert it in the plate holder. The Inspector will then enter on his street report the information called for on the form. The plate holder will then be given to the driver who will proceed to the dump.

On arrival at the dump, the Dumping Inspector or his assistants will take the plate holder from the driver after examining the load to see that it is up to specifications. He then directs the driver to dump his load and to return to him with his truck empty. The Dumping Inspector then inserts the plate holder into his imprinting machine. He then takes a receipt ticket, which is made in duplicate, stamps both tickets in the time clock and in the imprinting machine.

The time clock automatically stamps the date, the time, the machine number, the serial number and the Inspector's identification number. The imprinting machine prints on the ticket the data which has been embossed on the sectional plates, together with the load plate inserted by the Loading Inspector.

Each Dumping Inspector has a specific number which identifies him and his work, and he must insert the slide bearing his number in the time clock when he starts work and remove the same when he stops work and keep it in his possession. When the ticket has been properly marked, he gives one to the Contractor or his representative and this ticket is the Contractor's only receipt for the load; the duplicate is retained by the Inspector and is to be placed in a receptacle furnished for that purpose. When the load has been completely dumped and the truck is empty he gives the plate holder back to the driver. The truck then returns to the loading station.

The Loading Inspector's daily reports, the Dumping Inspector's daily reports, duplicate receipt tickets, load plates and plate holders will be turned over to the District Engineer at the end of each day's work, and he will compute the number of yards of snow removed from these records.

How to Obtain Accurate Cost Records for Public Works Accounting

By WILLIAM F. O'CONNOR

Cost Recorder, Dept. of Public Works, Troy, N. Y.

TO FURNISH a comprehensible control over the diversified activities that come under Public Works, the expenditures involved as to labor, material and equipment costs, an accounting system must be set up that will tell a true story and also act as a forecast for future budget estimates.

Public Works equipment, city pavements, sewerage and water systems and lighting systems all depreciate, and to make up this depreciation, purchases, repairs and payrolls are always ascending to take care of the wear and tear.

Thus you see it is ridiculous to assume that in any way guess work can be employed in estimating a city budget, especially when the operations of a particular department are wide and varied. Besides this, unforeseen storms and weather conditions come along as a stumbling block and unless this stumbling block is well taken care of, by an emergency sum, the budget will be out of order no matter how figures are compiled. This is an important item for consideration.

The system installed in Troy, N. Y., in 1931 by the Public Administration Service, after months of investigation, covers every detail in Public Works operations and this system is most worthy of consideration, in whole or in part, for any city large or small, if they want to obtain facts and figures that will not lie; facts and figures that can be shown to any taxpayer when said taxpayer starts to groan. A taxpayer is the most reasonable person in the world if you can show him when, how and where his money is spent. He is especially reasonable if he sees that it is being spent for public improvements. If you can't show him facts he grows suspicious. Then the trouble starts.

How to itemize the costs of operating a municipal public works department and use this as a basis for budgeting was for years considered an almost unsolvable problem. A few years ago Troy, N. Y., adopted a system developed by the Public Administration Service, and the cost recorder of that city says it works. How it works and how he works it, he explains in this article.

Troy's accounting system in its Public Works covers every detail, and to help the good work along, for those who might be interested, the procedure in obtaining costs will be explained.

Labor Payrolls

The following explanations cover labor payrolls, after which equipment costs will be explained.

STREET CLEANING BY HAND: Each foreman covering this particular operation turns in a true labor distribution with his weekly payroll. This labor distribution, balanced with the payroll as to hours and wage, also shows the names and lengths of each street cleaned and also mentions if repairs are in order.

STREET REPAIRS: *(Broken down into Dirt or Paved Streets.)* A labor distribution also covers this payroll with the names of the streets repaired. Material slips are attached, and after being certified they are passed on to the bookkeeper.

SEWERS—CESSPOOLS: *(Broken down into Sewer Repairs; Sewer Cleaning; Catch Basins cleaned by Eductor; Catch Basins cleaned by Hand.)* The same procedure as above is followed. Locations and materials used in operations are mentioned and totals of payrolls and distributions are balanced.

PARKS AND BOULEVARDS: The payroll is broken down and the cost of each park and boulevard is mentioned. Likewise with payrolls that cover GARBAGE AND ASH REMOVAL; DISPOSAL; BATHS; PUBLIC BLDGS.; DOCKS; WALLS; CEMETERIES and BRIDGES:

Another particular point brought out by a labor distribution is this: In the event that a foreman and his men change from one operation to another, as from STREET CLEANING to PAVED or DIRT STREET REPAIRS or to other operations, each operation is charged accordingly on the labor distribution that he turns in.

Thus the labor cost of every bureau in the department is readily and correctly obtained, with all particulars pertaining to the work accomplished.

As each item mentioned is a budget item, when the labor distributions are compiled at the end of each week a recap. is attached to the typed payroll and passed on to the bookkeeper and comptroller, who in turn debit each item on their books. When the full month's cost of labor is transferred to the WORK AND COST LEDGER, under the different budget items, the costs of operations are ascertained at a glance. They may be compared with costs of previous years; at the same time they act as a barometer for estimating future costs.

There is no other or more sure way than this for estimating true costs of past performances as true data for future operations. Guess work is out of order.

Equipment Costs

Troy has a model set-up in modern motor equipment. Every known piece of equipment applicable to public works operations is listed among the many motor-propelled units housed in the Public Works garage.

The system of handling equipment costs is as follows:

At the end of each work day the operators turn in an Equipment Operator's Daily Report, signed by the foreman under whose supervision the operator worked. These reports describe the nature of the day's operations, the location of the operation, the hours the operator and equipment worked and the miles covered. These reports must correspond with the locations mentioned on the labor reports or distributions.

STREET CLEANING BY TRUCK shows hours, miles and yards and location of operation.

FLUSHERS and MACHINE BROOMS covering set-up routes, show hours, curb miles, yardage and gallonage.

SEWER TRUCKS and EDUCTORS show hours, miles, basins cleaned with truck or eductor, yardage and location of operation.

GARBAGE AND ASH REMOVAL TRUCKS show section cleaned, hours, miles, and yardage moved to disposal location. (Troy has a double collection service each week; in the business section a collection every other day, and in all cases everything placed on the curb is carted away.)

STREET REPAIR TRUCKS, COMPRESSORS; ROLLERS and GRADERS show reports that go into all detail and cover all particulars regarding the day's operations.

Troy's equipment costs are easily estimated, as the hourly rental basis is used for all equipment. This is the only correct basis for getting costs on minor or major operations. These rates are established by past performances and include depreciation. Every 6 months they are checked or rectified.

As an example in getting a cost on a certain job: If the grader worked on Smith St. for 4 hours with a labor cost of $2.50 and an equipment cost of $4.00, or $1.00 per hour; and the roller with a labor cost of $2.50 with an equipment cost of $6.00, or $1.50 per hour; the combined labor and equipment cost for the Smith St. job would be $15.00. This operation would be listed under "Dirt Street—Repairs."

In figuring the cost of cleaning catch basins with the Eductor; catch basins by truck (hand); garbage & ash removal; flushing and cleaning with the machine brooms; the labor cost and hourly rental cost are always taken into consideration and with the units, as basins, miles, gallonage and yardage, the unit cost is easily calculated.

Office Records

Another novel feature in Troy's system is the record of work performed. This record is posted weekly in two books set up in alphabetical order for convenience, one book for Street Repairs and the other for Catch Basins and Cesspools.

The date the operation was performed, the location and the cost, especially as to street repairs, is most necessary as past experience in law suits has rendered these records a valuable source of information. The same pertains to catch basins and cesspools, odors from which are sometimes blamed for sickness. In all cases these records are true proof that services have been performed.

At the end of the month the cost recorder charges each budget item set up in his work and cost ledger with the labor hours, labor cost, equipment hours, and equipment cost. From the bookkeeper he receives a report of claims paid for repairs, light, fuel, phone, rentals, taxes, tires, auto parts, gas, oil, grease, auto and building insurance, materials and supplies

These amounts are also posted to each budget item and the commissioner's office salaries and expenses distributed according to the labor hours that each budget item shows for the month.

There thus is set up a permanent record that is most authentic, accurate, reliable and easily read and understood without extra mathematics and further search through other records.

Troy was one of the first cities to adopt this accounting system and since 1931 has become well known throughout the United States for its accurate set-up and interest in Public Works. Frank J. Hogan, a business man, is Mayor and Thomas F. FitzGerald is Commissioner of Public Works. Efficiency and economy is their motto and they are two important factors in the business life of Troy.

City Manager Reports by "Movie"

For the investment of $104.50, the city of Sewickley, Pennsylvania (population 5,599) has installed equipment for a completely novel system of "monthly reports" by the city manager to the town council.

This sum included $29 for a used 16-mm. movie camera (original cost $89), $57.50 for a slightly used projector, and $18 for a roll screen and tripod. The only additional cost is $4.05 per hundred feet of film, which includes developing.

This equipment was bought with the understanding that one or more films would be shown monthly by the city manager. In the first three months he took five hundred feet of film which: (1) gave the council a vivid idea of thirty old houses which were ordered repaired or demolished; (2) presented a zoning problem so cogently that it was disposed of at a single meeting; (3) showed the council exactly how a complicated "underground movement" had occurred in a concrete platform at the garbage disposal plant; (4) demonstrated visually the actual operation of sewage disposal plants in several other towns, thus eliminating the necessity of inspection trips.

In addition to these accomplishments, one reel was devoted to picturing Sewickley's garbage collection and disposal system in operation; another reel was devoted to the waterworks, and a third reel showed construction and repair operations on city streets and sidewalks.

The council is reported well pleased with the experiment, and now plans to make the reels available to schools and civic organizations in a campaign to educate the public in municipal affairs.—*Editorial Research Reports.*

Saving by Changing Meter Sizes

During the year 1937 the Water Bureau of Hartford, Conn., conducted extensive experiments by the use of a meter master rate recorder, to determine the actual rates at which water is used in different types of buildings.

As a result of these tests, it has been possible to reduce the size of meters in almost half the cases investigated, resulting not only in a saving in the cost of the meter and maintenance expense, but in many cases in a gain in revenue from increased registration through the more properly sized meter.

Based on the experience of a group of 39 meters, the net increase in registration through the smaller meters during the first six months of service, as compared with the last six months of service for the larger meters (which they replaced) was equivalent to an increase in revenue of about $25 per year per meter, and if compared with the like six months for the previous year, the revenue increase per meter was approximately $60 per year.

Thawing Frozen Services and Mains by Electricity

By J. E. GERMANN

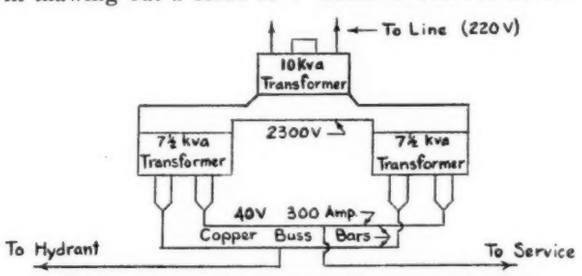
City Auditor and Waterworks Superintendent, Plankinton, South Dakota

A cold winter is coming! And water works men know that that means busy days—and nights—thawing services and mains. Probably all are familiar with electric thawing; but here's an article chock full of useful pointers and suggestions.

SO FAR I have had no trouble in thawing services and have successfully thawed out lead, copper, and iron pipes. Services require from three minutes to one hour; mains require a longer time. I use three transformers; one 10 kva and two 7½ kva. The larger transformer is reversed with the secondary lines hooked up to a 220 volt line. This steps up the voltage to 2300. The two 7½ kva transformers are connected as shown in the sketch. Copper buss bars are used to connect the two alternate sets of pigtails. One line then comes to the service and the other to a hydrant or main. The voltage is now stepped down to 40 volts and the current is about 300 amperes. The wire used to connect the buss bars to the service or main is 0000 wire, although it might be possible to use a slightly smaller wire without creating too much heat. Connections are made to any convenient point such as a faucet, hydrant, curb cock, etc.

It is possible to use these transformers connected in a slightly different manner to a 110 volt line instead of a 220. It would also be possible to use two 7½ kva transformers connected directly to a 2300 line, although there is probably more danger in working with the 2300 than with 220, especially if the men are inexperienced.

There is apparently no danger of melting the jointing material as long as there is water in the pipes, because as soon as the ice is melted the water will flow thus cooling down the pipe. We had a little difficulty in thawing out a block of 4" main. There was no convenient connecting point on one end so we made a hole down to the pipe and made the contact with an iron bar. After an hour or so there was still no water coming through so we left it connected all night. In the morning when we opened the hydrant no water came out, but after it had been opened for a few minutes water trickled through and finally the full flow came.



Wiring diagram for electrical thawing apparatus

The time required to thaw out pipes depends, of course, on the kind of pipe, the size of the pipe, and also on the amount of ice present. There may be only a small plug of ice or there may be ice from one end to the other.

The transformers are mounted on a trailer or truck and the wire is carried on a reel. This makes a conveniently portable thawing outfit. A two man crew is used. We have no information regarding the cost of thawing services as we have a Municipal Light Plant and the City does not make any charge to the water consumer.

Further Suggestions by F. J. Hirner

Further suggestions for the equipment to be used for this purpose are offered also by F. J. Hirner, of the Harnischfeger Corporation.

Any standard welding generator may be used for this purpose without alteration. Rugged construction, ease of operation, simple control and wide range of adaptability all tend to make the present day welder ideal for this application. As a stationary unit, it may be mounted in the bed of a light truck; or as a portable unit, it may be easily attached to a truck by the trailer tow bar. A gasoline-driven model welder is generally used because it is independent of electrical power facilities.

It makes no difference how the positive and negative leads are connected with respect to the pipe, but, where water mains are involved, it is generally possible to connect the leads to fire plugs, curb service cocks and other similar points.

In the case of house lead-in pipes, connection may be made to each side of the frozen pipe section so that the frozen part forms a part of the current circuit. Set the current indicator so that sufficient amperage passes through the frozen pipes.

It is impossible to state the exact current amperes and time required to thaw a given length of pipe. The type and size of pipe determine the maximum amperage that may be used. It is well to bear in mind that a lead pipe will melt at much lower temperature than a corresponding size of copper or iron pipe.

The condition of the soil, location of the pipe, extent of the freeze, the temperature of the air, the type and size of pipe, kind of joint and amount of current—all are factors determining the time required to thaw.

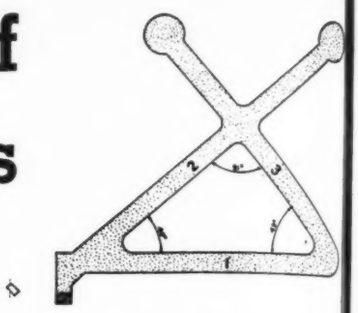
Thawing Data

Size of Pipe	*Recommended Current in Amperes*	*Approximate Minutes to Thaw*
¼"	70	14
½"	120	21
¾"	210	19
1"	220	28
1½"	300	31
2"	340	39
3"	410	58
4"	500	74
6"	500	118

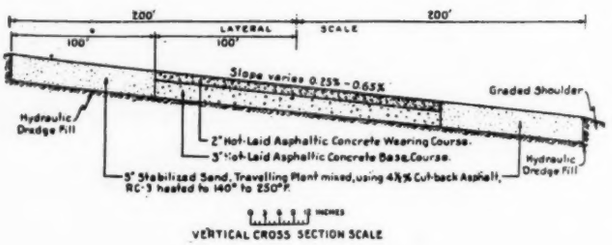
(Continued on page 32)

Construction Details of Asphalt Airport Runways

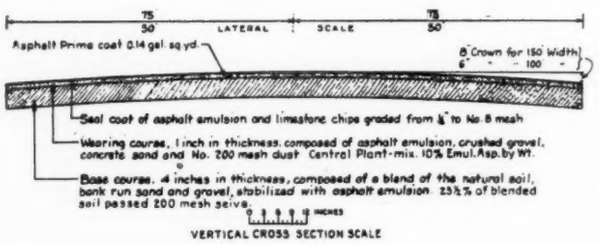
From data by W. R. Macatee of
The Asphalt Institute



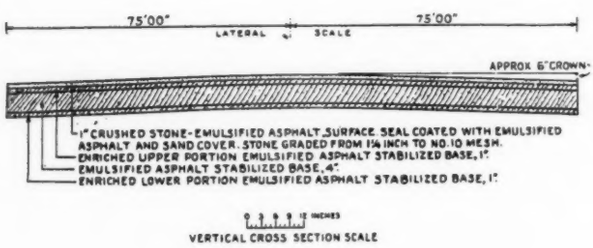
4—Municipal Airport, Pensacola, Fla



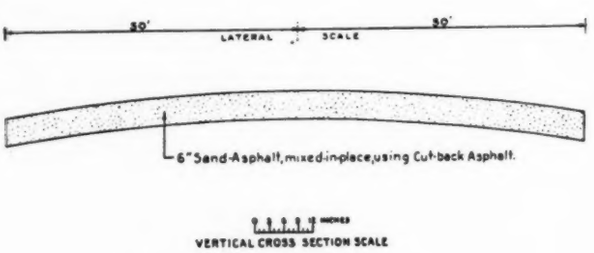
1—Reeves Field, Los Angeles, Calif.



2—Akron, Ohio



3—Maxwell Field, Montgomery, Ala.



4—Municipal Airport, Pensacola, Florida

Notes on Runway Sections Shown Herewith

Unless otherwise noted, costs are for surface, base and subbase only.

1. Reeves Field, Los Angeles, Calif., E. V. Earle, harbor engineer. Cost per sq. yd., 81 cents. Sand grading, 1.3% passed 200-mesh; 34.6% passed 100-mesh, and 86.5% passed 40-mesh.

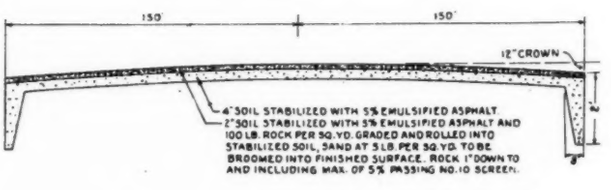
2. Akron, O., W. F. Peters, director of public service. Cost for surface, base and subbase, excl. grading, drainage and engrg., $1.56 per sq. yd.

3. Maxwell Field, Montgomery, Ala. Cost $1.35 per sq. yd., approximately. Coarse sand added to existing soil before stabilizing.

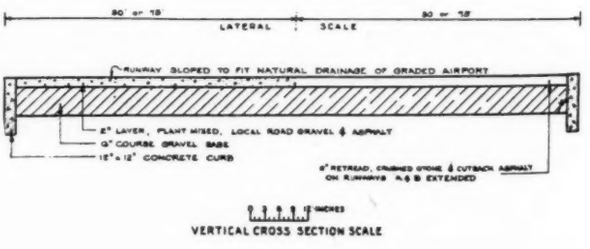
4. Pensacola, Fla., O. J. Semmes, Jr., city engineer. This field was constructed as a WPA project and costs are not available.

5. Los Angeles Municipal Airport, Los Angeles, Calif., Lloyd Aldrich, city engineer. Sidewalls of same material as base; base rolling done with rubber-tired, sheepsfoot and smooth rollers. Sealed with 0.25 gal. emul. asph. and 5 lbs. sand per sq. yd.

6. Memphis, Tenn., Municipal Airport, W. B. Fowler, city engineer. Plant mixed, average 9.17 sq. yd. per ton. Cost 78 cents per sq. yd.

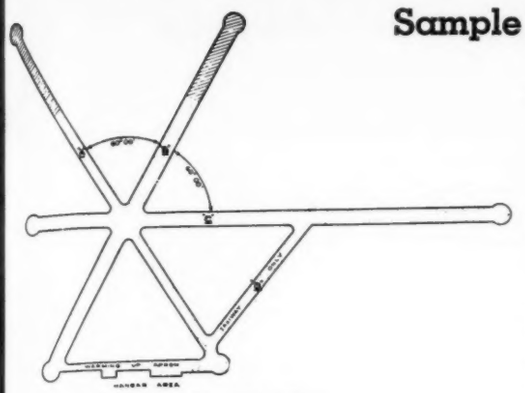


5—Los Angeles Municipal Airport, Los Angeles, Calif.

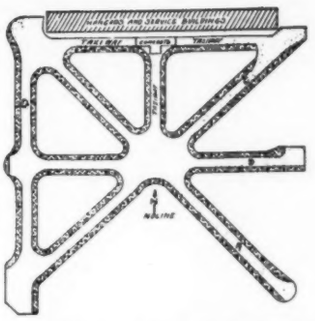


6—Memphis, Tenn., Municipal Airport

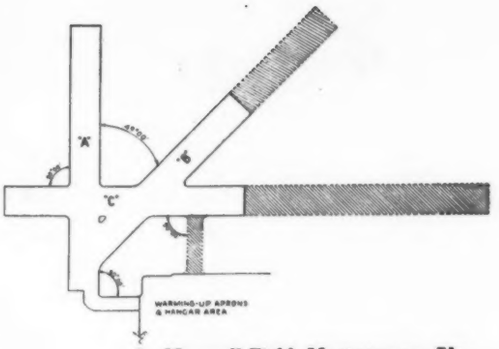
Sample Layouts of Runways



6—Municipal Airport, Memphis, Tenn.



Municipal Airport, Moline, Ill.



3—Maxwell Field, Montgomery, Ala.

7. Sioux City, Iowa, Municipal Airport. K. C. Gaynor, city engineer; subgrade, P. I. of 15, with 10-15% clay, 40-60% silt, 30-50% sand; 20 to 40 lbs. bearing value. Stab. base, P.I. not over 35, with 20% large gravel, 20% pea gravel, 42½% conc. sand, 5% river sand, 12½% natural soil; mixed and rolled with sheepsfoot. MC primer on base (0.67 gal.) if needed; 1½-in. surfacing of gravel, conc. sand, river sand, yellow clay and 6% MC-2.

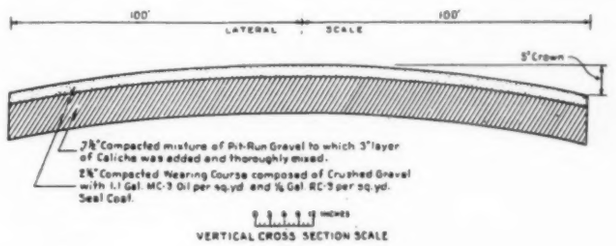
8. Concord, N. H., Municipal Airport. Edward E. Brown, city engineer. Cost 75 cents per sq. yd. Gravel base laid in 2-in. layers, wet, and rolled with 10-ton roller.

9. Albuquerque, N. M., Municipal Airport. Cost per sq. yd. 35 cents. Seal coat of RC-3 asphalt, 0.17 gals. per sq. yd.

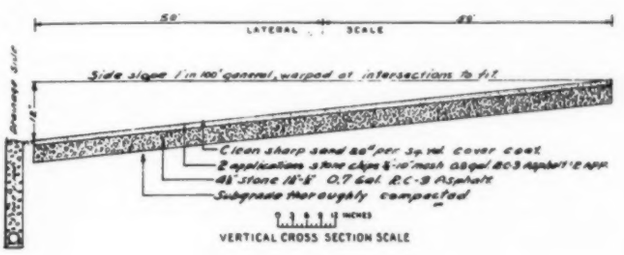
10. Iowa City, Ia., Municipal Airport. Fred E. Gartzke, City Engineer. Cost 42 cents per sq. yd. Cover coat 0.4 gal. RC-3 and 20 lbs. sand.

11. Tucson, Ariz., Airport. George W. Seeley, city engineer. Cost, 94 cents per sq. yd. Existing soil stabilized with 2 gal. emul. asph. per sq. yd., 4-in. depth, mixed with blades and harrows, water added, and mixed; surface ¾-in. penetration emul. asph.

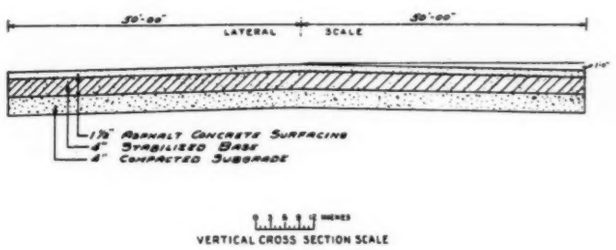
12. Newark, N. J., Metropolitan Airport. A. H. Armstrong, Principal Assistant Engineer, Department Public Works.



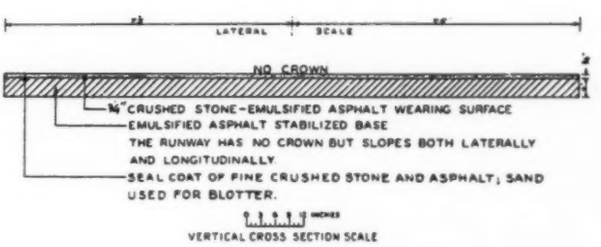
9—Albuquerque, N. M., Municipal Airport



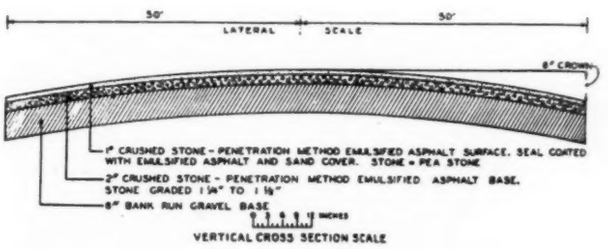
10—Iowa City, Iowa, Municipal Airport



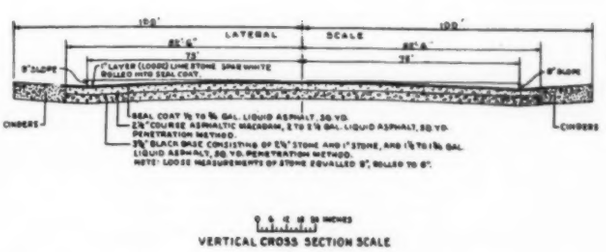
7—Sioux City, Iowa, Municipal Airport



11—Tucson, Arizona, Airport



8—Concord, N. H., Municipal Airport



12—Newark, N. J., Metropolitan Airport

Disposal of Garbage by Fermentation

About fifteen years ago the Beccari system of garbage disposal by fermentation was introduced into this country (see *Public Works* for June, 1923) but only three or four small plants have been built here, we believe. The idea originated in Italy, but has been tried out in other countries. In a recent report of the Association Generale des Hygienistes et Technicians Municipaux it is said that French constructors of such plants have, after long research, solved the principal difficulties involved in this process. As carried out at present, a modern fermentation plant operates as follows:

The garbage is dumped directly into a receiving trench and, without any preliminary treatment, is moved mechanically into a completely closed cell, where its subject to slightly compressed air. Here fermentation takes place in a manner favorable to the development of aerobic bacteria, especially thermophiles, by the combined action of air and water, both working downward from the surface and thus preventing the return of the gases of fermentation toward the charging apparatus. The temperature throughout the mass reaches 140° F in two or three days, 158° to 185° in four or five days, and remains at 150° to 165° until the material is removed, about the 20th day, pathogenic bacteria and vegetable parasites being destroyed. The fermented material is then screened mechanically into (1) unfermented rags and paper, (2) metals, (3) inert materials, (4) the mould. The rags and paper are burned and their ashes added to the mould; the metals are sold, the inert materials used as fill.

There is said to be no unpleasant odor. The gases soluble in water are removed with it through the drains; insoluble ones are removed by the downward forced draft and passed through a furnace. The mould is a fertilizer and improves heavy soils, and is eagerly sought at Cannes and other French towns where the system is in use.

Vibrated Monolithic Brick Pavement

A brick paving project on U. S. Route 21 in Ohio is the object of considerable interest. The design consists of a 3-in. monolithic brick surface course (without cushion) of an 9-7-7-9-in. reinforced concrete base course. There is a 1-in. expansion joint at 60-ft. intervals with a longitudinal center joint. The transverse expansion joint is of the assembled metal type with dowels and bituminous premolded filler with a cork extension in the brick surface. This joint is continuous from the bottom of the base to the top of the surface. The longitudinal center joint consists of premolded material which extends 2½-in. in the concrete base and has total depth of 5½-in.

The project differs both in design and in method of construction from the old type of monolithic brick pavement as constructed a number of years ago. In addition to proper provision for expansion and the elimination of haphazard longitudinal cracking, the most striking feature is the fact that the construction methods are mechanized to a large extent. The concrete base is vibrated with the usual concrete pavement vibrating machine and the longitudinal center joint is impressed as is usual in concrete construction, with the exception that the premolded material is left 3-in. above the top of the concrete to accommodate the brick surface. After the brick are laid directly on the green concrete base they are vibrated into place with a motorized self-propelling machine that travels on the

steel side forms. Vibration at the rate of 3,000 blows per minute is transmitted to the brick surface through longitudinal metal slats 5 ft. in length. This apparatus which is being used for the first time has been operated without delay or breakdown. A surface well within the specification requirements for smoothness is obtained. The grout filler is discharged on the surface of the pavement direct from a small mixer which is mounted upon a rolling carriage, and segregation of aggregates is thus eliminated.—*Highway Research Abstracts.*

Regenerating Zeolite Water Softeners

Under this heading we published, in our November issue, some comments made by H. M. Olson of the Ohio Salt Co. on the use of salt for regenerating zeolite softeners, in which he called attention to the use, for that purpose, of evaporated salt, which is free from the sand, shale, etc., contained in rock salt. Since then we have received a communication from a representative of the International Salt Company telling how brine that is entirely free from such impurities can be obtained at low cost from rock salt.

A brine that is saturated and of "complete purity and clarity" and "entirely free from insolubles" is said to be obtainable by use of the Lixate process, of which several hundred installations have been made for regenerating zeolite softeners for municipalities as well as textile plants, meat packing establishments, laundries, etc. Special grades of rock salt are used which do not cake or harden in the bin, and except for filling the bin and periodic withdrawal of the insoluble residue and cleaning of the dissolving tank, the process is automatic, adjusting itself to the demand, and no salt is wasted.

Pigs' Feet Require Strong Teeth

When Winnipeg, Canada, installed its new sewage treatment plant it included comminutors—then a comparatively new device. These worked fine except when abattoirs sent pigs' feet down with the sewage. These are so tough that the machines could neither cut nor tear them apart. (To do the company justice, it had refused to guarantee that they would.) The city ordered abattoirs to keep their pigs' feet at home, but these and sheep hides continued to reach the treatment plant. So the city discarded $38,000 worth of early vintage comminutors and bought others made of case-hardened steel with stellited cutters, which the manufacturers had meantime developed. Now it feels ready to handle anything but pig iron.

Long-Haul Scraping on a Wisconsin Highway

L. G. Arnold, highway contractor of Eau Claire, Wis., last spring was awarded a contract for grading 5 miles of trunk highway between Elk Mound and Colfax, Wis., which included 138,000 cu. yd. of rock excavation and a little over 100,000 cu. yd. of common excavation. The road is 34 ft. from shoulder to shoulder. The deepest cut on the job is 50 ft. in solid rock, and others approximate this. The longest fill is 2,055 ft. and three or four others run well over 1,000 ft.

Practically all excavated material is used in fills; there was less than 10,000 cu. yd. of burrow. This meant long haul for much of the material—up to 3,000 ft. in

some instances. This is usually considered too long for scraper haul, but Mr. Arnold used four 12-yard Le Tourneau scrapers drawn by Caterpillar RD8's; increasing his scraper capacities by using an Allis-Chalmers Model L to assist in loading the scrapers, the Caterpillar pulling and tractor pushing, thus increasing the normal load capacities 15%. The long haul and rock held the yardage to 45 an hour, but in light soils the scrapers average over 80 sq. yds. with this method of loading.

The excavation was in sand rock which, although soft, required considerable blasting to permit shovel excavation. But instead of using a drill, the contractor drilled with compressed air only in making holes for the dynamite. The shattered rock is handled by a Bucyrus-Erie 37B equipped with an Amsco 1¾ yd. shovel (which the experienced operator usually fills to 2 yd.), averaging 3,000 cu. yds. in two 7-hr. shifts per day. A set of dipper teeth was worn out in 84 hrs. of work and then resharpened, it being possible to resharpen a set 12 times. He preferred this to using a hardening alloy on the teeth.

Thawing Services and Mains

(Continued from page 27)

Cautions to Remember

Use welding cable of a size at least equal to that used for a similar current in arc welding. Care should be exercised to select cable of ample size, as otherwise considerable energy will be wasted by heating the cables. If long cables are used, this is very important. Make all cable connections to generator and pipe as tight as possible and see that all rust, grease, scale, etc., are cleaned off the pipe at the point of connection with the cables. Connect the cables as close to the frozen spot as possible—in other words, have as little excess pipe in a circuit as possible. Pass no current through the water meter. Check the gas pipe system to make sure that its pipes are not in contact with the water pipes. When thawing pipes in a residence or building, first open the house lead-in electric service switch to prevent the possibility of a short circuit or some similar complication. It is also advisable to disconnect the radio ground wire if connected to the water pipes.

An Unusual Bellmouth Spillway

In the construction of the new Dunwan reservoir for the county of Renfrew, Scotland, a bellmouth spillway was used which is believed to be without precedent in some of its main features. The chief novelty is that the spillway surrounds the outlet tower, the two being combined as one structure.

The water for consumption is drawn off at three different levels through 15″ pipes into a vertical 24″ pipe inside the tower; which pipe, reduced to 18″ diameter, is carried through the dam in a tunnel. This tunnel, 10 ft. in diameter, was used during construction to carry the stream through the dam, and is now used to carry the flood water which overflows the bellmouth weir.

The tower, 15 ft. outside diameter, is surrounded concentrically with a bellmouth 33 ft. diameter at the weir, reduced to a 21 ft. shaft, giving a 3 ft. annular space for carrying off the overflow water. The bottom of this annular space is paved and slopes toward the 10 ft. tunnel, to the mouth of which the shaft is connected.

The draw-off pipes pass through both tower and bellmouth shaft, being enclosed, where they cross the annular opening, in vertical concrete walls which connect tower and shaft.

Sewer Rentals in Ninety-two Municipalities

The experences of 92 municipalities with assessing and collecting sewer rentals have been ascertained by the Portland Cement Association and the data assembled in a table. These cities are located in 17 states and range in size from Buffalo, N. Y., with 560,000 population to Lawrence, Neb., with 528. Fifty-two are under 10,000 population.

Of these, 49 had financed construction with revenue bonds and 7 others mostly. Revenue bonds were used in this way in all the municipalities listed in Arkansas, Illinois, Indiana, New York and Tennessee.

The rate basis employed was the amount of water consumption in 35 cities, and this modified in 8 others. Among these modifications were: Water consumption for commercial use and flat rate for residences. Sewer rate combined with water rate. Water consumption to the extent that it discharges into the sewers. Water consumption plus a flat rate and connection charge. Based on winter month consumption. The flat rate method was used in 29 cases. The number of fixtures was used in 18 cases. Others used special devices such as 55% by water consumption and 45% against real property; flat rate and fixtures combined.

To the question whether bills were submitted monthly or quarterly, 40 replied monthly; 25, quarterly; 2 billed large users monthly, small ones quarterly; one billed the metered premises monthly, the flat rate ones quarterly; two billed some monthly, some bi-monthly; one billed monthly, quarterly and semi-annually, 3 semi-annually only, and one annually.

As to delinquencies, 9 reported none; 11, very small; 14 others less than 5%, and only 3 over 10%.

Protests against the tax were more or less serious in 6 cases; only at first in 4 others; only slight in 10 others; and none in 12.

In some cases the sewer rental charge is based on the cost of construction and operation of the treatment plant only and the cost of the collection system is financed from general taxation or special assessment. Greater attention, however, is being given to planning a rate schedule for sewer rental charges that will enable this one simpler method to cover the entire cost of the complete sewerage system.

Close cooperation with the waterworks department will permit the billing to be done from one office. With modern methods of accounting this will not entail much, if any, additional collection expense. Many municipalities have worked out ingenious methods of billing to meet their particular requirements. The simple statement showing separately the amounts charged for water and for sewer service is the type most generally preferred.

Laying Main Under Railroad Tracks

In laying a 12" water main under the four main-line tracks of the New Haven Railroad in 1937, the Hartford, Conn., Water Bureau placed it in an 80 ft. length of 36" concrete culvert pipe, 65 ft. of which was jacked under the tracks from a pit on the west side, and the remaining 15 ft. installed in the pits at the ends of the jacked section. Dresser couplings were used for the main through the culvert. A brick manhole was built at each end of it. The total bare cost of this construction, including manholes was $5,174.92, of which $2,834.82 was for jacking the culvert pipe, or $43.61 per foot of pipe jacked.

The Magno Filter for Corrosive Water

The Magno filter consists of a natural dolomite that has been roasted at such a temperature as to convert the $MgCO_3$ into oxide without decomposing the $CaCO_3$. The use of this filter is compared to aeration, lime treatment, filtration through marble, etc., for the prevention of corrosion of iron by water. In a recent article in *Vom Wasser*, it is stated that a marble filter must be five times as large as the Magno to be equally effective. Also, that the Magno filter is particularly suited to the treatment of soft waters, as in addition to reducing the acidity, the Ca content of the water is increased to a point where a protective coating is formed, a point not reached in the treatment of such water with the marble filters.

As the activity depends only upon the period of contact with the material, a very wide variation is permissible in the design and dimensions of the filter. Filtration from top to bottom is recommended, as washing is facilitated, and as the filter grains become smaller, they settle into the finer layers toward the bottom.

This process has been found in actual plant operation to render dissolved oxygen noncorrosive in hot water systems without removing it. As the layer of liquid immediately surrounding the Magno particles is a saturated solution of $MgO + CaCO_3$ of pH 9 to 10, ferric Fe, if not in organic form, is readily precipitated. Although oxygen is necessary for removal of the Fe, only the theoretical amount required to oxidize the Fe need be present, and not any large excess. If the water is soft and fairly large amounts of Fe are present, Mn is removed along with the iron by the simple filter; otherwise, the use of a layer of Magno previously treated with Mn compounds is recommended following the Magno filter. Filtration also reduces the bacterial content materially.

Improper Classification By City of Excavated Material

In an action by an excavation contractor against a city the New York Appellate Division, Silas Mason, Inc., vs. City of New York, 293 N. Y. S. 331, increased a verdict for the plaintiff from $2,992.05 to $24,553.58, on the ground that the contract and drawings properly construed indicated that the excavation in the disputed area was shaft excavation and not tunnel excavation; and that, as the Board of Transportation and its chief engineer certified, it was to be paid for as shaft and not as tunnel excavation. That the contract and drawings contained inconsistent or ambiguous provisions as to the type of work was held to be the responsibility of the city, which prepared the contract.

No Implied Warranty of Gravel Where Inspection Available

A construction company contracted to purchase gravel at a specified price per yard. In an action for the price its defence was that there was an implied warranty that the gravel would meet the Highway Department specifications and that this test had failed. The Oklahoma Supreme Court held (Hyde Const. Co. v. Stevenson, 72 P. [2d.] 354) that there was here no warranty such as to void the contract, the defendant having sought the plaintiff out and made the contract with him relying on his own judgment, and the contract not being made until after tests had been made.

The Waterworks Digest

Abstracts of the main features of all important articles dealing with waterworks and water purification that appeared in the previous month's periodicals.

120° V-Notch Weir Formula

Calibration of a weir made of structural steel angles fabricated to within 1/32 in., beveled at 45° to a sharp edge at the up-stream face and painted, set at the end of a stilling basin giving minimum side contractions of 2.5 times the head and a bottom contraction of 2.5 ft., gave (for discharges greater than 0.2 cu. ft. per sec.) $Q = 4.43H^{2.449}$, where Q is the discharge in cubic feet per second and H is the head measured 6 ft. up-stream from the blade.[L6]

Water Rates in England

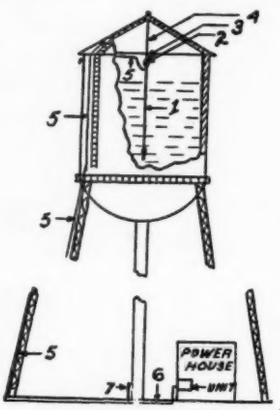
English law requires domestic water rates to be based on "the annual value" of the tenement supplied, interpreted as either rental or assessed value. "The principle of modern rating would appear to be based more on ability to pay than on services rendered. . . . Water undertakers, so far as domestic supplies are concerned, are rendering an essential service, and not selling a commodity." But in many cases an extra charge is made for every water closet exceeding one in a house and every private bath. Metering garden hose, as a luxury, is suggested.[D35]

A New Meter Test Chart

For plotting graphs accurately for loss-of-head tests of meters, ordinary cross-ruled paper either will not bring out the lower rates or requires too much space for the higher ones. Logarithmic paper is better, but the lower figures of the rate of flow scale occupy too much space and cannot be carried to zero. Another chart uses equally spaced vertical lines representing rates of flow, and horizontal lines spaced in accordance with the square roots of losses of head, giving a straight line loss-of-head graph. The latest chart, described in this article, has vertical lines spaced according to square roots of rates of flow, and horizontal lines according to the fourth roots of losses of head. This gives a straight loss-of-head graph and an accuracy curve that brings out clearly the lower rates of flow.[F71]

Electrical Rust Protection of Tank

A 200,000 gal. water tank at St. Clairsville, O., has been protected against rust by D.C. electricity, changed from A.C. by an 8"x9"x12" rectifier, current from which is carried to a stainless steel rod 1¼" diameter and 15 ft. long, suspended in the center of the tank and insulated from it, which serves as an electrode. Current from this passes through the water to



Water Works & Sewerage

Tank Equipped for Electric Protection

1. Solid Stainless Steel Electrode
2. Insulator—1,000-lb. Test
3. Wire Cable
4. Safety Cable
5. Service Cable Wire
6. Double Trenchlay Wire
7. Ground—Single Trenchlay Wire

the tank, which is grounded at the bottom of the riser. This loosened all corrosion and prevents further rusting, leaving a gray film coat which, when rubbed off with the finger, shows bright metal underneath. Cost $325. Operating cost, 20 kwh a month.[G42]

Use of Chlorine and Ammonia

Wide experience with the use of chlorine and ammonia in water supplies has apparently demonstrated that: 1. Where chloramines are used, a mixture of mono- and di-chloramines will prevail in the majority of places, the amount of each depending upon the pH of the water. 2. Chloramines may be added as "preformed" chloramines or "in bulk." 3. There is no set order of application—either ammonia or chlorine may be added first — depending upon local conditions. 4. Chlorine should be added in solution form and ammonia directly as a gas. In isolated cases, where the alkalinity of the water is low, less than 20 ppm ammonia may be applied as a solution. 5. The most common rato is one ammonia to three chlorine. 6. The chlorine demand for the chlorine in chloramines is nearly as great as with chlorine alone. 7. The test for chloramines is the same as for chlorine. 8. The chloramines are particularly useful in the treatment of water for: a. Sustained residuals in the distribution systems. b. The control of coli-ærogenes. c. Control of gas forming bacteria. d. Control of crenothrix and other iron bacteria. e. Control of red water and other dead end difficulties. f. Control of algæ. g. Control of tastes and odors.[X11]

Boiler Water Treatment

Neither privately nor municipally owned domestic water purification plants can supply a water which will be especially suitable for every boiler purpose. Each steam plant must prepare its boiler water to fit its particular conditions. To do this, it is necessary to know the composition of the boiler feed water; the services and counsel of experts who have made a study of boiler water conditioning and who have had experience with all types and combinations of conditions should be obtained; the necessary chemical water equipment, external and internal, must be installed to properly condition the water; and the dosage must be controlled by definite chemical procedure and analysis.[A145]

Automatic Control and Pumping Reliability

If use of automatic devices affords more safety and reliability, well and good. But such use is to be avoided if, when something goes wrong (as is possible in every plant) the complexity of the station is beyond the ability of the operator to do what is necessary to keep the plant operating or get it back into operation quickly. Maintenance must be more thorough. Elec-

trical equipment works well or not at all. Oil levels in transformers and bushings must be watched; relay settings recalibrated; contacts kept clean; motors be dismantled, cleaned and painted; dust, lint and cobwebs be removed. Spare parts, such as relay coils, motor coils, contacts, bushings, insulators, special fuses, should be available.[A152]

Chemicals for Preventing Corrosion

The amount of chemical necessary to render a water non-corrosive by saturating it with calcium carbonate can be ascertained by McLaughlin's method, using the marble test. Prof. Moore prefers Langelier's method as requiring much less laboratory work and being more reliable, and describes an application of it. This requires a determination of the pH of the dosed samples and the calcium content of the water; but the latter need not be determined every time, for it often remains constant over long periods of time, is usually a relatively fixed proportion of the total hardness. It is also necessary to know the dissolved solids content of the water, but only approximately, since an increase of these from 0 to 800 ppm. changes the constant K by less than 5%. The formula used is pH of saturation equals the constant K diminished by the sum of the two logarithms of the ppm of the calcium as Ca and of the alkalinity as Ca CO_3; K varying slightly with dissolved solids content and temperature of water.[B38]

"Short Schools" in Sanitary Engineering

"The waterworks short school is a palliative; it is not a cure; and it may fasten itself upon the industry as the delightful and soothing drug habit upon the addict. . . . Short schools are right in their place but they should not occupy the entire place in the educational activities of waterworks associations." "The waterworks industry may be stultifying its influence in the training of its recruits through the dissemination of inadequate and incomplete information during these short courses. The 'graduates' of the short courses feel themselves specially trained in the field of knowledge covered by the course. Employers feel that attendants at such courses have received basic knowledge. The attendants are usually older and more experienced than the more thoroughly trained recent college graduate. The 'job' or the promotion is given to the short course graduate and discouragement is given to the 'long course' man who has received more thorough training for the practice of waterworks engineering."[A140]

Maintaining a Distribution System

Reservoir must be fenced. Wooden fences require a great deal of maintenance—wire fences much preferable. In Manchester, N. H., screens at reservoir inlet and outlet are removed and cleaned twice a year. Service leaks caused by leaking of lead goose necks cause 75% of their trouble. Only two leaks with copper services, used since 1927, and these caused by improperly made joints. Frozen services are thawed by an Engessor thawing machine. Other equipment owned includes 3 portable air compressors, 3 gasoline-driven pumps, a Homelite generator set with lights, a Toledo gate opening device, 2 portable steam boilers, a pipe locator, a leak finder, sonophones, dipping needles, meter master.[B39]

Algae As Indicators of Water Conditions

Likely algae flora can in many cases be foretold from the main characteristics of the water concerned. There is an annual periodicity of occurrence and succession of different species in a given lake or reservoir. Other changes

are caused by changing conditions, as by increase of sewage or other organic matter entering a lake, or by the decrease of same. Thus conversely, changes in algae conditions give information concerning changes taking place in the character of the water.[D36]

Rock Shattering Without Blasting

In excavating hard sandstone rock without defined bedding planes (for constructing a reservoir), where blasting was not permitted, use of compressed air proved slow, and charges of compressed carbon dioxide fired electrically was tried, and shattered the rock with the minimum of disturbance to the surrounding ground.[D39]

Air Raid Precautions in England

Air raid officials consider that the only probable danger for reservoirs is arsenic from arsenical smoke gases, and this is not serious. Poisoning by chemicals or bacteria is possible; the remedy, chlorine or chemical treatment. Duplicate pumping plants at least 100 yds. apart are recommended. A reserve diesel plant in a hut surrounded by earth is recommended. Pipe lines under ground are probably safe. Filter beds are not very vulnerable; if damaged, chlorinate during repairs. Service reservoirs are invisible if covered. Dams are difficult to hit from the air; sand bags to plug small openings are suggested, and keeping water level low.[D37]

Bibliography of Waterworks Literature. The articles in each magazine are numbered continuously throughout the year, beginning with our January issue.

c. Indicates construction article; *n*, note or short article; *p*, paper before a society (complete or abstract); *t*, technical article.

A *Journal, American Water Works Ass'n October*

140. The Training of the Sanitary Engineer. By H. E. Babbitt. Pp. 1595-1604.
141. Changes in Water Utility Accounting. By E. W. Morehouse. Pp. 1605-1612.
142. The Continuing Property Record and Its Uses. By C. H. Lamb. Pp. 1616-1622.
143. Preparation and Uses of a List of Retirement Units. By W. J. Schwartz. Pp. 1623-1626.
144. The Plant Ledger—What It Is and Why. By H. T. Mathews. Pp. 1627-1629.
145. Boiler Water Treatment. By P. W. Frick. Pp. 1630-1634.
146. Developments in Soil Corrosion and Pipe Protection. By F. N. Speller and V. V. Kendall. Pp. 1635-1650.
147. Microscopic Growths in Distribution Systems and Their Food Supply. By A. M. Buswell. Pp. 1651-1654.
148. The Chickasaw, Alabama Filtration Plant. By A. C. Decker and J. E. Jagger. Pp. 1655-1664.
149. Charges for Private Fire Protection. By R. Newsom. Pp. 1665-1667.
150. Private Fire Service Charges. By J. H. Murdoch, Jr. Pp. 1668-1670.
151. Liquid Chlorine: A Critical Review of Chlorine Specifications and Accidents. By L. L. Hedgepeth and W. S. Riggs. Pp. 1671-1683.
152. Can Purchased Electric Power or Diesel Power Be Made as Reliable as Steam Power for Pumping Stations. By W. V. Weir, R. H. McDonnell, H. C. Henning and W. W. Hurlbut. Pp. 1684-1701.
153. Plumbing Hazards and Their Evaluation. By A. P. Miller. Pp. 1702-1715.
154. Metering as an Aid to Water Works Administration. By M. F. Hoffman. Pp. 1716-1722.
155. Safeguarding Water Revenue. By H. L. Meites. Pp. 1723-1727.

B *Journal, New England Water Works Ass'n September*

37. Development of the Water Supply of the City of New York. By J. Goodman. Pp. 259-310.
38. *t.* Calculation of Chemical Dosages Required for the Prevention of Corrosion. By E. W. Moore. Pp. 311-317.
39. Maintaining a Distribution System in Northern New England. By J. A. Sweeney. Pp. 318-323.
40. Bristol's New Filtration Plant. By J. A. Newlands. Pp. 324-330.
41. *t.* Thread Gage Design and Threading Problems. By O. E. Koehler. Pp. 331-342.
42. Experiences in Watershed Sanitation. By M. S. Wellington. Pp. 343-350.
43. Connecticut's New Plumbing Regulations as Affecting Water Supplies. By L. K. Sherman. Pp. 351-363.
44. *t.* Economic Design of Hydraulic-Fill Dam Sections. By H. H. Hatch. Pp. 364-377.

D *The Surveyor November 4*

32. Softening Pit Water at Ossett, England. Pp. 509-511.

November 11

33. Renfrewshire's New Reservoir. P. 545.

November 18

34. *p.* Protection of Underground Sources of Water Supply. By E. Morton. Pp. 565-566.

---

35. *p.* Water Charges. By J. F. Haseldine. Pp. 567-568.
36. *p.* Algae As Indicators of Water Conditions. By M. Rosenberg. P. 568.
37. *p.* Air Raid Precautions and Water Supply. By J. M. Bonham-Carter and A. J. G. Bird. Pp. 571-572.
38. *p.* Avoidance of Frost Bursting in Water Pipes. By J. McKeown. Pp. 573-574.
39. Widnes' New Reservoir. Pp. 577-578.
40. *p.* The Nitrogen Balance of Large Bodies of Water. By C. H. Mortimer. P. 578.
41. *p.* Mechanical Flocculation of Water and Sewage. By R. C. Gibbs. Pp. 587-588.

E *Engineering News-Record*
November 10

47. Water Meters in Indianapolis. By W. W. De Berard. Pp. 593-596.
November 24
48. The Colorado River Aqueduct, History, Technical Features, Construction. Pp. 637-684.

F *Water Works Engineering*
October 26

69. Artesian Well Drilled in Desert. By M. Raineau. Pp. 1412-1413.
70. *p.* Study of a Water-Borne Epidemic of Gastroenteritis at Vinton, Ia. By C. F. Jordan and C. D. Mullinex. Pp. 1441-1442.
November 9
71. Analysis Charts for Meter Tests. By E. Nuebling. Pp. 1472-1475.
72. *p.* Experiences in the Sterilization of Mains in Distribution System. By B. A. Poole. Pp. 1494-1497.
73. *p.* Removal of Fluorine from Water. By H. T. Dean and others. Pp. 1497, 1498, 1501.

G *Water Works & Sewerage*
November

40. The New Filter Plant of the St. Louis Co. Water Co. By W. V. Weir. Pp. 1023-1028.
41. *p.* Manganese and Iron Deposits. By R. B. Adams. Pp. 1043-1046.
42. A New Method of Tank Protection. By O. B. Hess. Pp. 1049-1050.

J *American City*
November

20. Willimantic Water Works Hit by Hurricane. p. 51-54.

K *Proceedings, Am. Soc. of Civil Engineers*
November

6. *t.* Analysis of Run-off Characteristics. By O. H. Meyer. Pp. 1769-1786.

L *Civil Engineering*
November

6. *t.* Determination of a Formula for the 120° V-Notch Weir. By R. A. Hertzler. Pp. 756-757.

M *Canadian Engineer*
November 1

13. *p.* The Forgotten Main. (Cleaning Mains). By J. A. Frank. Pp. 12-14.

P *Public Works*
November

46. Preventing Electrolysis of Three Forks' Distribution System. By F. F. Palmerson. Pp. 15-16.
47. Building a Circular Concrete Clearwell. By S. P. Matthews. Pp. 20-21.
48. *n.* Regenerating Zeolite Water Softeners. P. 35.

W *Johnson National Drillers Journal*
September-October

6. A study of the Yield of Water Wells. By H. O. Williams. Pp. 1-7.

X *Journal, Pennsylvania Waterworks Operators Assn. Year 1938*

7. *t.* Fundamentals of Chemistry as Applied in Water Works Operation. By J. J. Shank. Pp. 61-69.
8. Experiments in Filtration. By H. J. Krum. Pp. 70-75.
9. The Ideas of a Small Plant Operator. By A. E. Clement. Pp. 76-81.
10. Lubrication of Waterwork Machinery. By B. F. Hunter. Pp. 82-87.
11. Chlorine Plus Ammonia. By A. E. Griffin. Pp. 88-97.

Materials Used in Construction Not Sold As Such

Contracts for the construction of concrete sewers and tunnels and sewage treatment works for a sanitary district required two types of materials, temporary materials for shoring, etc., and materials embodied in the permanent structures—sand, cement, gravel, reinforcing steel and the like. The Illinois Supreme Court held, in a suit to enjoin the collection of an occupation tax (Herlihy Mid-Continent Co. v. Nudelman, 367 Ill. 600, 12 N. E. 2d. 638), that the contractors were not persons transferring these materials for use or consumption and not for resale, so as to be subject to the tax under the Illinois statute. They were the persons "using" these materials although they became part of the structure whose title vested in the sanitary district. What the sanitary district bought under its contract, if there was a sale at all, were sewers and sewage treatment works, completed and ready for use. Under these circumstances the transfer of the materials could not be regarded as a sale, there was no transfer of tangible personal property within the meaning of the act, and the contractors were not subject to a tax.

The Sewerage Digest

A Digest of the Sewerage Literature of the Month giving the main features of all the important articles published

Partial Digestion At Anderson, Ind.

Anderson received bids in November for a plant to treat an average of 8 mgd (16 mgd maximum) in primary tanks, and a limit of 12 mgd by the Guggenheim process. The sewage contains about 225 ppm suspended solids and 170 ppm B.O.D. The chemical sludge from final settlers is pumped to a sludge thickener with 18 hrs. storage capacity, or directly to the digestion tank, the primary function of which is to act as a "leveling basin" or repository of variable flows of sludge of variable nature to provide a more uniform product for dewatering on vacuum filters and with a high fuel value; a storage capacity of only 12 days being provided, with additional depth of 3 ft. for supernatant. No gas storage is provided, although probably enough gas will be created to heat the tanks, incinerate the sludge (mixed with ground garbage), heat the building, etc. Two vacuum filters of 400 sq. ft. total area are provided. There will be an incinerator with capacity to burn 60 tons of 70% moisture filter cake in 24 hrs.[G39]

Air Raids and Sewage Works

England, in taking air raid precautions, is not overlooking its sewage treatment works. Underground sewers are considered sufficiently protected. Percolating filters cover too great an area to be seriously damaged. Most vulnerable are pumping stations and rising mains. Serious consequences from damage to these can sometimes be avoided by providing by-passes to streams. Rising mains should be in duplicate along different routes. For pumping stations, the only protection against a direct hit is duplication. For protection against splinters, a special building is proposed with windows and doors protected by curtain walls. Internal combustion engines are preferred to electric, as the wires bringing current may be broken.[D63]

Separating Cans From Incinerator Residue

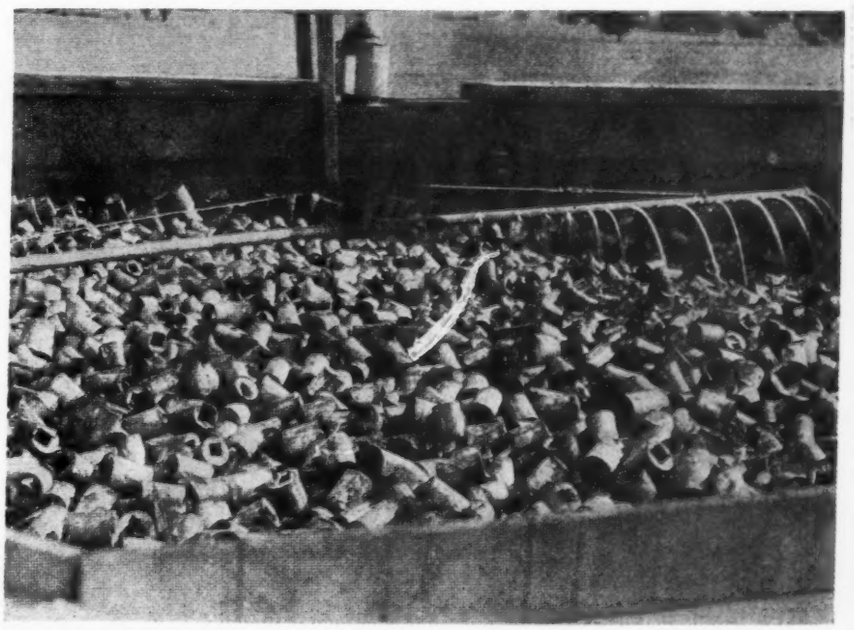
Toronto, Ontario, destroys its mixed refuse in three high-temperature incinerators, with a fourth small plant operated six months a year at a summer colony. During the past year or so the department has experimented with screening the ash and clinkers of the residue from the tin cans, which during some periods of the year constitute 80% of the total volume of the residue, and proposes to construct an ash screening building which will include mechanical equipment and bins for storing the different parts of the residue. There is a market for the cans, dump space will be conserved, and nuisance at the dumps eliminated.[M5]

Tin Can Filters

Experiments have been conducted at Baltimore, Md. and Wellington, O. by Sealtest Research Laboratories with trickling filters using, as aggregate, empty evaporated milk cans, 7 oz. and 14 oz. capacity, bright in some filters, rusty in others, with a large hole punched in each end. The effluents were treated by 1 hour in settling tanks. About 1570 small cans in an 18.8 cu. ft. filter 6 ft. deep gave an exposed surface of about 530 sq. ft. and 720 large cans gave 475 sq. ft. Using three filters in series, with 16 mgad on each filter or 5.3 mgad on the total area, an average BOD removal of 0.12 lb. per cu. ft. per day was obtained; at 34 mgad BOD removal increased to 0.20 lb. with temperature at 56°; the final effluent had a BOD of 364. At the 16 mgad rate, in warmer weather, the final BOD was 100—the best result obtained by any of the tests.[C86]

Paint At Sewage Pumping Plant

From experience in painting concrete walls and metal surfaces in the underground Marina pumping plant in San Francisco, the following conclusions were drawn: 1 — For concrete walls exposed to sewage and gases, no sunlight, bituminous base type of coatings are by far the most successful. 2—For iron and steel submerged in raw sewage or exposed to gas, the greatest deterioration is caused by grit and flotsam in the sewage, and bituminous enamels fortified with high grade synthetic resins have given good results. Constant repainting may be necessary to offset abrasion. 3—For iron and steel surfaces exposed to slightly gaseous conditions, high grade machinery enamels using the best type of synthetic resins are satisfactory if applied carefully—success depends entirely on the prime coat. Aluminum paints exposed to concentrated gaseous conditions, high humidity and without sun-



Sewerage Works Journal

Top view of can trickler at Wellington, Ohio

light, tried with various types of vehicles, were unsatisfactory—color darkened to a very dark gray. Scale must be removed from steel before painting—the most effective method is by sand blasting and shot blasting.[C92]

Rate of Oxidation Of Organic Material

Under natural conditions, oxidation occurs only in the presence of living biological agents, as a result of the metabolic activity and proliferation of living bacteria, and is proportionate to the number of cells produced; and the oxidation occurring during any time interval is proportional to the amount of food or organic material utilized by the bacteria. To these conclusions from earlier studies, the authors have added by later studies on the effect of variations in the initial numbers of bacteria and of the dispersion of sludge flocs on the course of oxidation of organic material. The bacteria used were Bact. aerogenes. Incidental conclusions were that from 1,000,000 to 5,000,000 bacterial cells per m l. are required to produce an oxygen requirement of 1 mg. per liter; and that in pure culture activated sludge with a suspended solids content of about 1,000 ppm (dry weight), the bacterial content is at least 10 billion per m l. Major conclusions were: (1) The rate of oxidation of bacterial food during the early hours of incubation is dependent on the number of living units of bacteria present at the start; the greater the initial numbers the more extensive the initial oxidation. (2) The rate of oxidation is also influenced by the degree of dispersion of bacteria, or bacterial flocs, in the presence of a dispersed food; adequate dispersion is required to produce oxidation. (3) A logical explanation based on this influence of bacterial numbers and their dispersion on oxidation, is provided for the mechanism of the very rapid rate of oxidation obtained with pure culture activated sludges and of the same phenomenon as it occurs in the activated sludge process of sewage treatment.[C83]

Reducing Leakage Into a Pipe Sewer

A 48″ concrete b & s sewer in Janesville, Wis., was found to be leaking 4.1 to 5.3 mgd in a length of 7,000 ft., water entering through the lowest third of almost every joint. About 3 mgd of this was eliminated by caulking the joints from the inside. To permit this, semi-circular dams were set in the sewer several hundred feet apart, and by means of water siphon ejectors, the sewage was pumped upstream from dam to dam to a point where it could be discharged into a river. With the sewer practically empty at a given point, the joints there were raked out, a slot cut with an air chisel in the bottom half of the joint and in this was caulked jute, followed by strips of lead of widths varying from ⅜ in. to 1¼ in., which were caulked with compressed air tools. Three crews of 4 men each were used in 8-hr. shifts—a compressor operator, cutter, caulker and helper. Caulking 7,628 lin. ft. of sewer cost $7,476.[E30]

Variable Capacity Settling Tank

At Alte Emscher, Germany, a settling tank is in use which smooths out variations in volume of flow of sewage and in composition by means of a contrivance for automatically varying the contents of the tank between 2,500,000 and 3,300,000 gal., giving 1¾ hr. detention for the varying rates of dry weather. The tank is circular, outward flow, 222.75 ft. diameter. The depth is varied from 10 ft. to 13.25 ft. by means of floating telescopic outlet weirs (71 in number) set around the outside wall. Each weir consists of a pipe 7⅞ in.

When you need special informatioa—consult the *classified* READER'S SERVICE DEPT., pages 55-57

diameter with one end fixed in the outside wall and the other turned into a vertical position and provided with a flange to support the four vertical telescoping tubes. The outer tube carries an annular bronze float, adjustable so as to regulate the flow over the top of this tube, which acts as a weir. If water in the tank rises, the weirs do also; but as the float has to carry additional telescoping tubes, the weir settles more below the surface, thus increasing the discharge gradually as the depth increases. Incidentally, the walls are built of steel piling coated with 1¼" of fine concrete on each side, held in position with wire fabric welded at intervals of 3' 3" to the piles.[D62]

Financing Sewerage in Pennsylvania

Four methods are available to Pennsylvania municipalities for financing sewerage projects, two of them quite recent. 1—General obligation bonds. The limit of borrowing capacity is 2% of assessed valuation without the consent of the electors, and 7% with the consent. There is a question how much of this total should be used for sewerage, and whether unsewered property should be made to pay for it. 2—Assessing abutting property. This has been the most popular; can not cover cost of treatment plant, trunk lines, etc. 3—Separate municipal authority, which can issue bonds, with authority to meet interest and sinking fund charges and also the cost of operation and maintenance of the system by charging for use of the sewers. 4—"Non debt revenue sewer bonds," considered the most satisfactory; similar to No. 3 but the revenues are collected by the municipality itself and constitute a lien on the property; and charges can include a 10% margin of safety as well as those covered by No. 3.[C84]

Activated Sludge Treatment of Sulfur Dye

Studies of activated sludge treatment of sewage containing black sulfur dye waste (one of the most difficult of all textile wastes to handle) in an experimental plant, led to the following observations and conclusions: Activated floc was formed slightly more rapidly when the sewage contained 1% by volume of dye. Color removal was greater when the floc added had been produced by aeration of sewage without dye, but lost this advantage with repeated use. Variations in the amount of air supplied had little effect on B.O.D. reduction and color removal, but *rate* of aeration had considerable effect on reduction of suspended solids in the 4- and 6-hr. periods, the 6-hr. being decidedly better than the 4-hr.; however, the 9-hr. showed little additional improvement. The suspended solids concentration in the aeration tank had a decided effect on color removal, this being almost directly proportional to the amount of floc present up to a concentration of between 2500 and 3000 ppm, after which practically no improvement in effluent was gained by increasing the solids. Variations in the amount of floc had little effect on the reduction of B.O.D. and removal of suspended solids. Under all conditions of operation, the aeration tank containing the most floc best withstood sudden changes in composition of the sewage-dye mixture being treated and produced the best appearing effluent.[C85]

Disposal of Dairy Wastes

It is practicable and economical to prevent milk losses, collect rinsings, and dispose of spoiled products, excess skim milk, whey and buttermilk in almost all milk plants without sewage treatment. Cooling water can go to storm sewers or streams. Spoiled or excess products should not reach sewers

in small cities unless so regulated that the pH at the city disposal plant never goes below about 6; nor streams except very large ones; lagooning is objectionable because of odors; use for animal feed, if possible, is recommended; evaporation and drying are too expensive; gas production in digestion plants is suggested; waste disposal plants have to be large and expensive, although digesters with trickling filter to handle the supernatant are suggested. With waste minimized, washings from cans etc. can generally go into sewers or streams except small fish streams; aerated flow-equalizing tanks are often desirable; septic tanks may be very useful, sometimes followed by mechanical aerator or high-rate filter; trickling filters, Guggenheim process and activated sludge process have proved satisfactory in some plants.[C86]

Bibliography of Sewerage Literature. The articles in each magazine are numbered continuously throughout the year, beginning with our January issue.

c. Indicates construction article; *n*, note or short article; *p*, paper before a society (complete or abstract); *t*, technical article.

C *Sewage Works Journal*
September

83. *t.* Effect of Variations in Initial Numbers of Bacteria and Dispersion of Sludge Flocs on Oxidation. By C. T. Butterfield and E. Wattie. Pp. 815-838.
84. Legal Aspects of Financing Sewerage Projects in Pennsylvania Municipalities. By G. F. B. Appel. Pp. 839-855.
85. Treatment of Sulfur Dye Waste by the Activated Sludge Process. By H. J. Miles and R. Porges. Pp. 856-867.
86. Dairy Waste Elimination and Sewage Disposal. By H. A. Trebler, R. P. Ernsberger and C. T. Roland. Pp. 868-889.
87. Automatic Shut-off for Gas Still. By J. R. Snell. Pp. 890-891.
88. Primary Sludge Pumping. By W. H. Wisely. Pp. 891-893.
89. Operating Results at the Laguna Beach Sewage Disposal Plant. By R. D. Woodward. Pp. 893-895.
90. Thermometer Gadget for Use in Digesters. By W. A. Sperry. Pp. 895-896.
91. Paint Pointers. By C. F. Tennant. Pp. 897-899.
92. Experience with Paints at the Marina Sewage Pumping Plant. By J. Corrao. Pp. 899-907.

D *The Surveyor*
October 21

58. Keeping Sewage Disposal Records and Statistics. By R. S. Tayler. Pp. 435-436.
59. *p.* The Present Trend in Sewage Purification. Pp. 437-439.
60. *p.* Sanitary Works in Large Buildings. By W. C. Easdale and D. Easdale. Pp. 457-458.

October 28

61. Sewage Purification at Oldham. Pp. 471-472.
62. *p.* Some Recent Developments in Settling Tanks. By H. L. Folkes. Pp. 475-478.
63. Air Raid Precautions with Regard to Sewerage Schemes. By L. B. Escritt. P. 483.

November 11

64. *p.* A Fermentation Process of Refuse Disposal. P. 544.

E *Engineering News-Record*
November 3

30. Caulking Sewer Joints to Cut Leaks. By J. Lustig. Pp. 553-555.

G *Water Works & Sewerage*
November

39. Bio-Chemical Treatment for Anderson, Ind. By R. B. Moore. Pp. 1029-1034.
40. Bio-Flocculation at New Brunswick, N. J. By H. W. Gehm. Pp. 1072-1074.

H *Municipal Sanitation*
November

59. Solving the Wards Island Scum Problem. Pp. 522-523.
60. U. S. Bureau of Mines Warns Against Explosions in Sewers and Manholes. P. 523.
61. Oxy-Acetylene Welding in Sewers and Plants. By F. R. McCleary. Pp. 524-525.
62. Maintenance of Settling Tank Mechanism. By L. M. Johnson. Pp. 529-532.

J *American City*
November

27. *c.* City Makes Own Storm Sewer Pipe. By E. Toness. Pp. 59-60.

L *Civil Engineering*
November

10. *p.* Progress in Control of Water Pollution in New York State. By A. F. Dappert. Pp. 742-744.

M *Canadian Engineer*
October 25

3. *p.* Financing Municipal Works. By W. C. Miller. Pp. 26, 28, 30, 32, 34, 36.
4. *p.* Storm-Water Sewer Design. By W. B. Redfern. Pp. 38-44.
5. *p.* Refuse Incineration Plants. By J. A. Burnett. Pp. 44, 46.

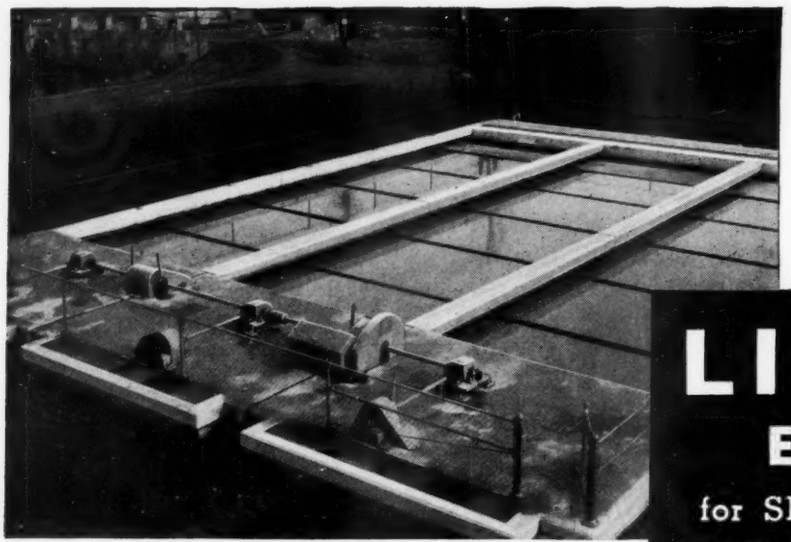
P *Public Works*
November

42. *p.* Designing a Grit Removing Plant. By A. R. Vollmer. Pp. 9-11, 28.
43. *n.* Sewage Disposal Progress in California. P. 18.
44. Hartford Metropolitan District Sewage Treatment. P. 22.
45. *n.* Pollution in the Ohio Basin. P. 46.

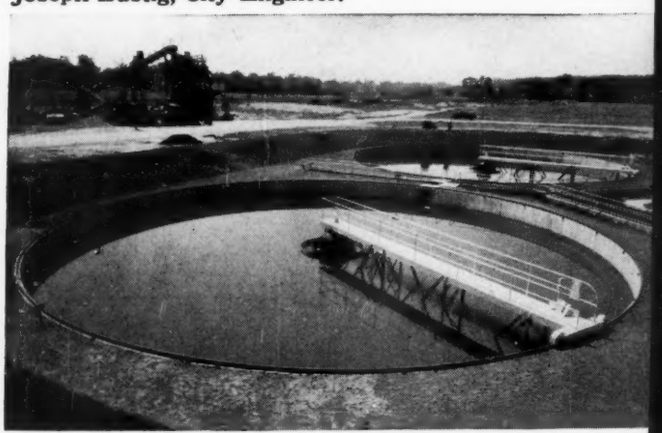
T *Technique Sanitaire et Municipale*
September

2. Le Transport des Eaux Usées dans les Plages. Pp. 167-169.
3. La Destination Finale des Eaux d'Egouts. Pp. 169-177.
4. La Destruction des Ordures Menageres des Plages. By R. Humery. Pp. 178-186.
5. L'Alimentation en Eau et L'Assainissement des Plages Fluviales et Lacustres. By M. Dufournet. Pp. 187-188.

When you need special information—consult the *classified* READER'S SERVICE DEPT., pages 55-57



Link-Belt STRAIGHTLINE Collector. High efficiency, long life, low maintenance and positive removal of sludge make the STRAIGHTLINE Collector the preferred unit for removing sludge from rectangular settling tanks. This installation is at Janesville, Wis. Joseph Lustig, City Engineer.



Link-Belt CIRCULINE Collector. It has all the advantages of the STRAIGHTLINE type collector with the added advantage of low cost concrete construction for large tanks. This installation is at Dayton, Ohio. M. D. Tatlock, Consulting Engineer and Superintendent.

The Link-Belt STRAIGHTLINE Mechanically Cleaned Bar Screen has spaced parallel bars on which the larger floating solids in incoming sewage collect, and a mechanically operated rake for removal of the accumulating solids, thus assuring an even flow of sewage through the channel. The machine may be set vertically or inclined, and used in small or large plants. This one is at Appleton, Wisc. Greeley & Hansen, Consulting Engineers.

STARTING NEXT MONTH

the most complete and up-to-date text on

HOW TO MAINTAIN HIGHWAYS AND STREETS

Answers 98% of the questions that arise in regard to maintenance.
Contains over 80,000 words . . . complete, authoritative, new.

To run serially in PUBLIC WORKS
starting in January, 1939

WHEN one of PUBLIC WORKS' editors was looking up something about maintaining highways last summer, he discovered:

There was no up-to-date, authoritative source of information to which anyone could turn and quickly find the answers to a majority of his questions about street and highway maintenance.

Fills long felt want

The many State Highway Departments, Cities and Counties that were consulted were almost unanimous in their replies that practically nothing worthwhile was available on the subject and that information would be of great value.

So PUBLIC WORKS decided to prepare a book length text on Maintaining Highways and Streets which will bring together in one place for the very first time *complete information* on highway maintenance . . . just what the 10,000 superintendents, engineers, supervisors and others out in the field have wanted but could not get.

50 Leaders help prepare text

Work on HOW TO MAINTAIN HIGHWAYS AND STREETS has been underway for several months under the direction of W. A. Hardenbergh, Asso. Editor of PUBLIC WORKS, in collaboration with more than 50 prominent highway engineers representing all parts of the nation. It will be published in five installments, in the January, March, May, July and August issues of PUBLIC WORKS Magazine . . and nowhere else.

Here's what one prominent State Highway Engineer wrote after examining a preliminary draft of the first installment: **"I never read practically 67 pages, which you sent me containing the first portion of your text on HIGHWAY MAINTENANCE, that contained such good practical information. It is certainly a masterpiece. . . . Everyone interested in construction or maintenance of roads should read this and take time to digest it."**

Here is a partial table of contents

1—Introductory

2—Essentials of Maintenance Common to All Roads
- a. The Traveled Way or Surface
- b. Shoulders
- c. Traffic Service
- d. Drainage
- e. Roadsides
- f. Structures
- g. Plant and Equipment
- h. Handling and Storing Materials

3—Maintenance by Types
- a. Earth, gravel, etc.
- b. Bituminous Secondary Types
- c. Bituminous Primary Types
- d. Brick
- e. Concrete
- f. Other

4—Soils and Their Classification
(Detailed outline covers 40 headings)

5—Equipment and Materials Used in Construction

This brief outline gives only a faint idea of this big, new text of over 80,000 words and many illustrations. Every engineer and official dealing with the question of maintenance will find the complete series of these articles indispensable.

Don't miss the first installment. Use the coupon to enter or renew your subscription now.

MAIL THIS COUPON

PUBLIC WORKS, 310 East 45th St., New York, N. Y. 12-38

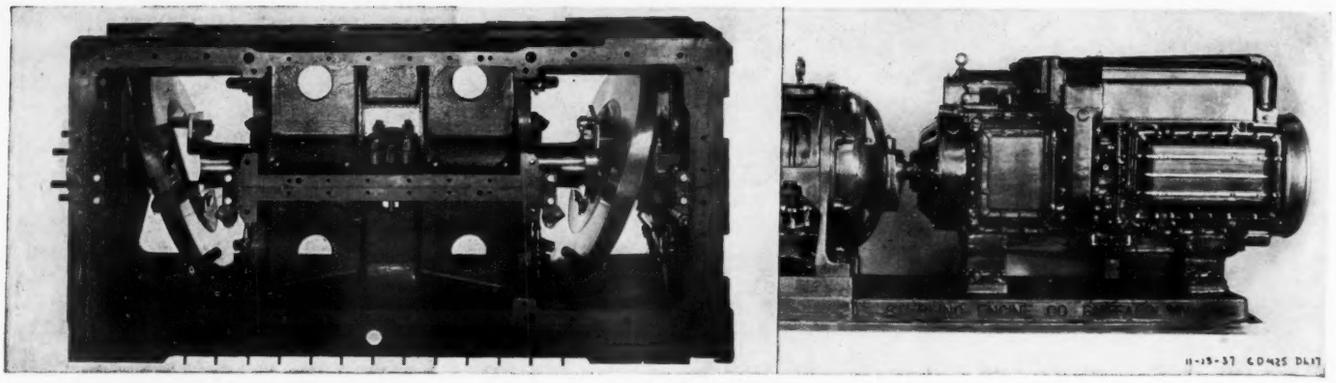
Please enter my subscription for PUBLIC WORKS for one year starting with the January issue containing the first installment of How to Maintain Highways and Streets. I will remit $3.00 on recipt of your bill.

Name.....

Title.....

Street.....

City..... State.....



The Sterling Crankless Diesel Engine; main shaft and inclined power discs at left. 100 k.w. engine and generator set at right.

Sterling Engines at the Power Show

THE Sterling Engine Company exhibit at the Power Show—Space 64, Main Floor, Center Aisle—consists of a Sterling Petrel 6-cylinder stationary engine, approved by the Associated Factory Mutual Fire Insurance Company, and the National Board of Fire Underwriters, for direct connection to fire pump at 1750 R.P.M. This is a six cylinder engine, 5¼" bore, 6" stroke, with a rating of 170 H.P. at 1750 R.P.M., built with the attention to balance of centrifugal and inertia forces necessary to make this speed practicable. The crankshaft is counterweighted and dynamically balanced, a feature of many automobiles, and a Sterling practice for twenty years. These counterweights relieve the bearing loads and enable the crankshaft to revolve centrally in the bearings. A second feature, which promotes high speed running, is the light weight valve employed. The inlet and exhaust valves weigh 12 ounces each. Valve seats are inserted. The third major feature is the Sterling patented aluminum piston, which has no vertical split in the skirt and which is fitted as tightly as a cast iron piston. It is particularly successful because the expansion of aluminum is controlled, and not allowed to exert pressure on the cylinder wall, nor distort the piston pin bosses. A high pressure lubricating system is employed, including oil cooler and filter, which cools and filters all of the oil before delivery to the bearings.

These engines are uniformly built with dies, jigs and fixtures, so that each engine is an exact duplicate of its predecessor. After years of service any part ordered for replacement will fit accurately, without remachining or filing.

Other Sterling engines have similar characteristics, and all are approved by Underwriters' Laboratories. The larger of the engines is run normally at 1200 R.P.M. The engines are also built to operate on natural gas for continuous service at 900 R.P.M.

While the Sterling Power Show Exhibit will include one of the smaller types of engines, the large Viking series is on display at their New York Office, 900 Chrysler Building.

There is also on display at the Power Show the Sterling crankless, internal combustion, compression ignition oil engine, which is rated for continuous service on 135 H.P. load at 1200 R.P.M. Many of these engines are in service. This new model represents the second size developed by Sterling in this special design. It is rated for a normal load of 90 Kilowatts, with ample capacity for overload. These engines employ opposed pistons, which also act as the valves, uncovering the air intake and exhaust ports in timed sequence. Cylinders are scavenged and subsequently super charged by a positive displacement air compressor, built into the engine. The output of the compressor is distributed by a rotary valve to the air ports, initially scavenging the cylinder clean, and then, as the exhaust piston closes the exhaust ports, the air, at about 5 pounds pressure, fills the cylinder with a fresh charge, which is compressed, by the movement of the two pistons, to approximately 500°. The opposed pistons work in horizontal cylinders. They transmit their power through a ball-and-socket type thrust bearing of the Kingsbury or Mitchell type, through to the two flywheels—or discs, as they are called—at each end of the engine. These discs are mounted at an angle, or inclined. The combustion pressure is applied through the thrust bearing against the face of the inclined disc. The pressure exerted against the angle of the disc causes it to rotate. The pressure of the pistons is so confined that the power must be exerted against the disc . . . it cannot be dissipated in any other way.

The engines are equipped with electric starters and generators, and batteries for starting: they are furnished with all necessary accessory equipment—in fact, everything but the foundation, the piping for fuel, water and exhaust, and the fuel tank.

These engines are not characterized by a Diesel "knock" and there is no untoward sign of operation. They start very readily without the use of glow plugs or other devices, moving from electric starter into full running action very smoothly.

Due to the absence of cylinder heads there is comparatively little heat lost, with the result that the combustion chamber is properly and instantly warmed, to correct running temperatures. The engine has no crankshaft, no cylinder heads, no gaskets, no rocker arms or valve action. There are four cylinders, arranged quadrangularly, and in each cylinder there are two pistons, working opposed, transmitting the power directly to the flywheels.

A complete description of the engine is offered in the Sterling catalog.

Motors are retained on test at Buffalo for demonstration, and the yacht Silverheels, owned by C. A. Criqui, President of Sterling Engine Company, is now enroute from Buffalo to Miami, Florida, for her third season, demonstrating the engines at the principal seaports en route, and probably returning from Florida about May, and being again available to those who wish to observe the engines in operation.

Mack Has a Diesel Truck

A diesel engine driven truck has been announced by Mack Trucks, Inc., Long Island City, N. Y. This is available in a 131 hp motor, which can be obtained in the present Mack models BM, BX and CJ. The engine is used in the Mack-Lanova, which is 6-cylinder and 4-cycle.

Mack has also announced a light gasolene powered truck, the ED, which has a gross capacity of 8500 pounds, while the chassis weighs 3100, leaving 5400 pounds for body and load.

Hough Tractor Snow Sweepers

These snow sweepers are fine for cleaning snow from sidewalks, driveways, streets, parking places, rinks and many other places. They attach to nearly all makes of industrial wheeled tractors. Models include the one-way and a tuway, the latter being able to sweep either to the right or to the left, with immediate change of direction possible. Bulletin 107 describes these. Frank G. Hough Co., 919 No. Michigan Ave., Chicago, Ill.

Keeping Up With New Equipment

NEW equipment, designed to take its place in the field in 1939, is now beginning to appear. No doubt more of it will be announced within the next two months.

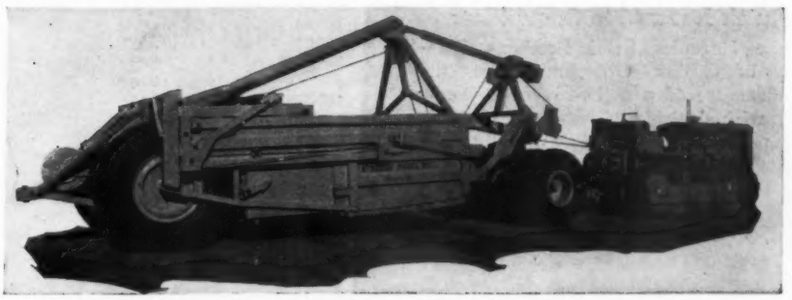
Allis-Chalmers "S" Tractor

Thiis is a new gasolene tractor, much the same in appearance and performance as the S-O (an oil tractor). This new machine is especially designed for snow-plow work; for handling scrapers of 7 to 8 cu. yd. capacity; 12-ft. blade graders; 10-yard wagons; bulldozers; trailbuilders, etc. It weighs 18,000 to 19,000 pounds and develops 77.66 horsepower, with a drawbar pull of 16,700 pounds. Speeds are 1.52 to 6.37 miles per hour. Two tread widths—62-inch and 74-inch. The engine is 4-cylinder, and is reputed to have a remarkable economy—0.5 pounds fuel per brake hp at 80% to 90% full load for continuous service.

Allis-Chalmers have also brought out a new pusher attachment for tractors. This was described and illustrated last month. For large dirt-moving apparatus, like the LeTourneau scrapers mentioned below, a pusher is economical. In fact, Le Tourneau say that a pusher is economical on any scraper of more than 15 yds.

Bigger and Better Scrapers

A 30-yd. scraper is announced by Le-Tourneau—the RU Carryall. Heaped, the capacity is 30 cu. yds.; struck measure capacity is 22.2 yds. Says LeTourneau regarding this: "Constructed for big profits . . . and expected to play a money-saving role. . . ." It will spread loads to a mesaured depth of 24ins. Four 18 x 24 inch tires in front, and two 24 x 32 tires at the rear—these stand 80 inches high.



Le Tourneau RU (above) and Z Carryall Scrapers

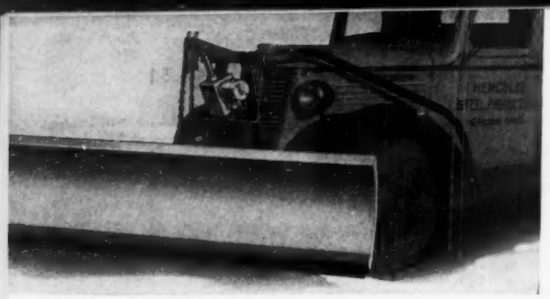
A smaller sister is the "Z" Carryall, also recently announced. Struck capacity of this is 2.7 cubic yards; heaped, 3.5 to 4 yds. Spreads its load up to 14 ins. deep. Seems to be specially suited for small road work, general embankment and other moderate or small dirt-moving jobs. Handled by a 35-hp. tractor. All of the four wheels are mounted within the width of the scraper blade, so that you can do backsloping, ditching, etc.

Allis-Chalmers Tractor and Scraper

Paintgrip—A New Armco Product

A new kind of galvanized sheet metal with a special phosphate coating bonded with the zinc promises longer life and greater economy in highway signs. Advantages are said to be greater paint adherence, lower initial cost, and greater resistance to sharp blows of flying stones or the "practice bullets" of traveling sportsmen. Signs made of this metal are said to remain legible and attractive longer than signs made of ordinary galvanized metal.

The special surface of the sheet gives greater paint adherence and insulates the paint from the drying-out effect of zinc, according to the manufacturers. Spalling or powdering of some galvanized sheets during fabrication of signs, often encountered by fabricators, are said to be eliminated by use of this metal.



Hercules Quick-Reversible Snow Plow

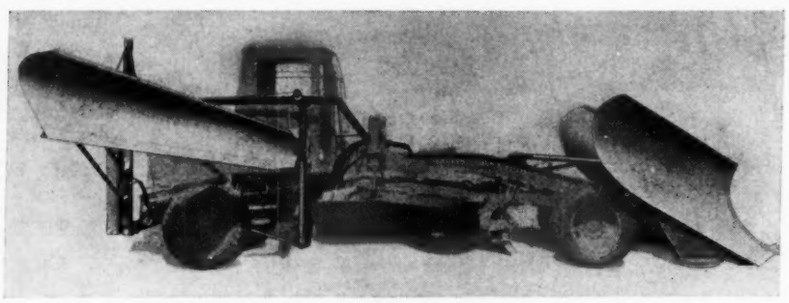
Quick Reversible Snow Plow

The Hercules Steel Products Company of Galion, Ohio, announces the manufacture of a quick-reversible snow plow with electrically operated hydraulic lift. This plow, for 1½- and 2-ton trucks is known as the Hercules model A snow plow. This plow uses a Meyer safety blade, which enables the plow to scrape directly on the pavement. The blade operates as a safety trip, riding the plow over ordinary road obstructions without the use of springs or other generally employed tripping devices.

Snow Plows for the A-W "99" Motor Grader

Snow plows have been announced by Austin-Western Road Machinery Co., Aurora, Ill., for their "99" motor grader. These include the standard V plow which has a cutting width of 9 ft. and flares to an overall width of 11 ft.; the Giant V plow, which is designed to use the 4-wheel drive and steer of the "99" to remove deep snow at high speed; plowing width is 9′ 2″, overall width 12′ 7″; also wings for moving plowed snow farther to the side, for cleaning up after plowing, and for handling a wide cut in light snow. With regular moldboard, a width of 18′ 2″ can be cleared in one pass.

The plows are handled by the same hydraulic controls that operate the scarifier, and machines either with or without scarifier can be equipped with these plows. The wings are also hydraulically controlled from within the cab. Austin-Western have a folder on this which will be sent on request to them or to us.



Snow blades and wings for Austin-Western "99".

International Diesel Trucks

The International Harvester Diesel line of trucks includes 6 four-wheel models ranging in capacity from 3 to 7½ tons, with gross vehicle weight ratings from 17,200 to 38,000 pounds. Body, cab, and pay load allowances on the various four-wheel models range from 9,300 to 23,400 pounds.

A Diamond T Truck being loaded by a Barber-Greene elevator, which is picking up gravel scraped to one side preparatory to oiling a Kansas road. It takes 2½ minutes to load a 2½-ton truck.

Also, 5 six-wheel models ranging in rated capacity from 2½ tons to 15 tons, with gross vehicle weight ratings from 24,000 to 62,000 pounds. Body, cab and pay load allowance for the six-wheelers are from 13,300 to 41,100 pounds. Four wheelbases are available in each of the four-wheel models and in the two smaller six-wheelers. Three of the six-wheelers are available in three wheelbases and the largest model in two wheelbases.

Diesel power plants in all these Internationals are the Cummins 4- and 6-cylinder types. Both engines have 4⅞-inch bore and 6-inch stroke, the 4-cylinder having 448 cubic inches piston displacement and the 6-cylinder 672 cubic inches. Air brakes are standard equipment on 6-cylinder models and available for 4-cylinder units. A six-ton diesel was exhibited at the Motor Truck Show.

This man is not looking over the new Austin-Western outfit opposite, though such a helmet might be excellent for plowing snow. This efficient-looking headpiece is a chrome leather welding helmet made by Industrial Products Co., Phila., Pa.

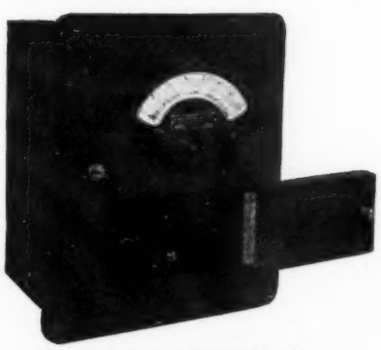
New Diesel Trucks by International

Continuous, Automatic pH Indicator

This pH indicator will give continuous pH records. It may be mounted on a wall or panel, in any convenient location. The meter, with 6-inch scale and large, easily legible figures, indicates 0.1 pH directly, between the values 3 and 10. Other ranges are available, such as 0-7 and 6-13, as standard; ranges other than standard may be had.

The electrodes may be installed in permanently grounded flow lines without effect on the readings. The glass electrode is internally shielded to prevent electrostatic interference. Temperature compensation is automatic.

A striking and valuable feature is the fact that it makes provision for connection of a controller or recorder of the automatic potentiometer type, and for any desired number of meters to give indications at distant points. Built into the



Continuous, Automatic pHer

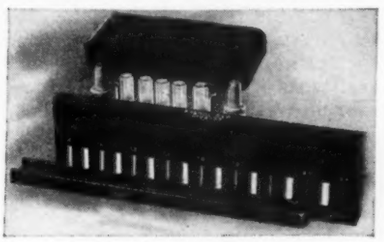
case is an automatic voltage regulator which takes care of fluctuations of line voltage of 10% each way from normal.

The Central Scientific Co., 1700 Irving Park Blvd., Chicago, Ill., state they will be glad to give any readers a detailed explanation of the application and limitation of this instrument to their particular problems, but ask that in writing for information or advice, the problem be described.

New Taylor pH Slide Comparator

A new slide comparator for the colorimetric determination of pH, chlorine and phosphates, developed by W. A. Taylor & Co., 872 Linden Avenue, Baltimore, Md., is molded entirely from plastic. A marked improvement in appearance, durability and ease of handling results and the weight has also been reduced. All pH, chlorine and phosphate values, as well as the indicator names, are engraved in white directly on the plastic slides. Improved catches are used to hold the top on the base and all metal parts are rustproof. The whole outfit, including the slide is 10 in. long, 2⅛ in. wide and 4 in. high and weighs only 1½ lbs.

The new comparator consists of a slide and a base. Each slide contains 9 color standards alternating with ampoules of distilled water. All color standards are guaranteed by the manufacturer to maintain their accuracy for a period of 5 years. The base contains 2 vials of indicator solution, with 0.5cc pipettes, 5-5cc test tubes, and a piece of etched glass in a special compartment. Determinations are made by filling three of the test tubes with the test sample, adding 0.5cc of indicator solution to the middle one, placing the slide on the base and moving it back and forth until the test sample matches one of the color standards. The pH, chlorine or phosphate value is then



Taylor pH Comparator

read off directly from the values on the slide. One base can be used with any number of color standard slides. Fuller information from the manufacturer.

A Sanitary Garbage and Refuse Unit

The new Gar Wood garbage and refuse unit, the load-packer, is a modern, sanitary, all-enclosed body. It compresses, like a hydraulic baler, all kinds of bulky rubbish and garbage into a compact mass, full-capacity load that is much greater in weight than the usual loose load. When the load is compressed, excess water is squeezed out.

The load-packer can be built in various lengths, widths and heights to fit any truck or trailer chassis. The loading

The Gar Wood garbage unit. Rear view closed shown below

trough located close to the ground, simplifies loading by shovel or from baskets and cans. The garbage and rubbish are not exposed and odors are confined. Papers cannot blow off. Every available cubic foot of the body can be filled. The body can be cleaned easily.

A help in counting bacteria

A Help in Counting Bacteria

The "Quebec" colony counter provides dark field illumination and bright dividing lines for making counts. The oblique light, which cannot glare into the eyes, illuminates the colonies so that they appear as brilliant spots on a subdued background.

The case is made of sheet metal and so mounted on a standard that the whole apparatus can be adjusted to the comfortable and natural position of the technician. This apparatus is handled by the Fisher Scientific Co., 711 Forbes St., Pittsburgh, Pa., who will send more detailed data on request.

Everson Swimming Pool Sterilization Bulletin

Everson Manufacturing Co., Chicago, Ill., have recently completed a new and informative bulletin on water sterilization with sodium hypochlorite. This describes the Everson safety electric sterilizer. This instrument produces sodium hypochlorite electrically from ordinary rock salt and water, meets all municipal, state and federal health requirements.

Sodium hypochlorite (NaOCl), widely used in the home under many trade names, is not irritating to the skin or membranes, hence it is peculiarly suited for swimming pool sterilization, even with a relatively high dosage.

The manufacturer claims that it costs only 10c to 15c per day to operate this instrument on an ordinary indoor pool. The new bulletin illustrates and describes this new apparatus in detail, explains its operations and installation.

Streamlined Dodge Trucks

In addition to appearance, Dodge has many new things for 1939. One of them is the Dodge 3-ton diesel engined truck, which has a 6-cylinder, 4-cycle engine. The remarkable fuel economy of the diesel makes this extremely interesting to users of 3-ton trucks. In addition, of course, Dodge continues most of its usual line of trucks.

Among these are two 1½-ton standard and heavy duty trucks, with gross ratings of 10,000 and 12,000 pounds, and wheelbases up to 160 ins. Also the 2-ton models, with a maximum gross rating of 14,000 pounds; and the 3-ton, both gasoline and diesel.

A great many improvements have been incorporated in the 1939 Dodge trucks which cannot be mentioned here. Probably the best thing to do is to get literature or see the new trucks at your local dealer.

Carroll E. Johnson

News of Folks in the Public Works Field

Clarence J. Velz has been appointed head of the Civil Engineering Department and Professor of Sanitary Engineering at Manhattan College, New York City. A new hydraulic laboratory is being constructed at the college, and plans have been made for a sanitary engineering laboratory.

J. R. A. Hobson, jr., is the new director of public utilities of Richmond, Va. Formerly assistant PWA administrator, Mr. Hobson is well known in Richmond engineering circles.

Carroll E. Johnson has been appointed assistant advertising manager of the International Harvester Co., Chicago, Ill., succeeding A. C. Seyfarth recently promoted to be advertising manager.

E. R. Galvin, former general sales manager of the Caterpillar Tractor Co., has been appointed general sales manager of R. G. LeTourneau, Peoria, Ill.

Donald A. Robison, treasurer of Caterpillar Tractor Co., Peoria, Ill., has been made general sales manager of that company.

Koppers Company's Western Gas Division, Ft. Wayne, Ind., manufacturers of hydrants, valves, etc., has been absorbed by another division of the Koppers Co., the Bartlett Hayward Division. Sales and engineering activities were moved Dec. 1 to Baltimore. Walter F. Perkins, vice president of the Koppers Co., will be in charge of the combined divisions.

American Cyanamid & Chemical Corp., New York, has acquired a site at Georgetown, S. C., and will install there a plant for the production of sulphate of alumina.

Fort Worth, Texas, has purchased 1000 Calmet piston meters from the Well Machinery & Supply Co. There were previously 1600 Calmet meters in use in that city.

Everett Moses, formerly Manager Eastern Division, Dempster Brothers, Inc., has been appointed as Northeastern Representative for the Brooks Equipment & Mfg. Co., of Knoxville, Tenn. Mr. Moses will specialize on the sale of Brooks load luggers, for the present, but later will handle Day jaw type rock crushers and swing hammer crushers, manufactured by the Brooks Company.

G. V. Aldridge, formerly in the Sales Department of The Hug Company, manufacturers of the Hug Truck, has joined the Brooks Equipment & Mfg. Co., of Knoxville, Tenn. Mr. Aldridge will specialize in the sales of the Brooks load lugger in the Southwest and on the West Coast.

E. R. Galvin

Municipal Public Health Engineers

The Conference of Municipal Public Health Engineers was formed during the 1938 Sessions of the American Public Health Association, with the following officers:

Chairman—Joel I. Connolly, Chicago, Illinois; Vice-Chairman — Aime Cousineau, Montreal, Canada; Secretary-Treasurer—Alfred H. Fletcher, Memphis, Tennessee; Executive Committee: James L. Barron, Nassau County, New York; Arthur E. Gorman, Chicago, Illinois; Henry C. Lane, Minneapolis, Minnesota; F. Gardner Legg, Detroit, Michigan; Sol Pincus, New York City, New York.

The first meeting will be held one day immediately preceding the 1939 Convention of the American Public Health Association. This new organization will provide a medium for an exchange of ideas relating to the problems of the municipal public health engineer, to the end that the various activities, studies, measures, methods and administrative procedures for carrying on effective engineering health programs and that cooperation to the mutual benefit of the Conference of State Sanitary Engineers, and the Engineering Section of the American Public Health Association, may be encouraged.

Sanitary and Public Health Engineers in health, water, industrial and similar related departments of municipalities and urban areas are eligible for membership.

Index to ADVERTISEMENTS

Readers' Service Department

Help Yourself to These Helpful Booklets

These booklets are FREE. Use the coupon or write the manufacturer direct, mentioning PUBLIC WORKS.

Construction Materials and Equipment

Air Compressor from Ford Parts

5. How you can convert an ordinary Ford model A or B motor into an air compressor for operating jackhammers, paving breakers, clay spaders, tampers, paint sprays, etc., is explained in a new bulletin just issued by Gordon Smith & Co., Desk G, 516—10th St., Bowling Green, Ky.

Cold Weather Concreting

28. This useful, illustrated booklet on "Cold Weather Concreting," explains how to minimize winter costs and outlines the best methods to use in winter work. Sent free by Lone Star Cement Corp., Room 2203, 342 Madison Ave., New York, N. Y.

Concrete Accelerators

30. "How to Cure Concrete," a forty-seven page manual published by the Dow Chemical Company, Midland, Michigan, treats fully subject suggested by title.

31. "Curing Concrete Roads with Solvay Calcium Chloride," 30 page booklet. Comprehensive. Contains tables, illustrations, suggestions for testing devices. Covers the subject in considerable detail. Solvay Sales Corp., 40 Rector St., N. Y. C.

36. "Wyandotte Calcium Chloride and its use in Portland Cement Concrete," a booklet covering the subject of curing concrete pavements, structures, etc., giving complete specifications for surface and integral curing. Published by the Michigan Alkali Co., 60 East 42d St., New York, N. Y.

Concrete Mixers

44. Catalog and prices of Concrete Mixers, both Tilting and Non-Tilt types, from 3½S to 56S sizes, The Jaeger Machine Company, 400 Dublin Ave., Columbus, Ohio.

Culverts

60. "In diameters up to 10 feet and larger . . ." just issued by the Armco Culvert Mfrs. Assn., tells a good deal about drainage problems and their solution. 32 pages about drainage and multi-plate culverts.

Dirt Moving

65. "Dirt Moving," is a new 32 page booklet illustrating the use of Trac Tractors as a source of money-making power for bulldozers, bullgraders, wheel scrapers, fresnos, graders, dump wagons, tampers, etc. 24 pages of action pictures, directions, etc. Sent promptly by International Harvester Co., 180 No. Michigan Ave., Chicago, Ill.

Distributors

71. A handsome 14 page catalog, well illustrated in colors, tells how the 3 big features of the Littleford "Model C" pressure distributor work and why this machine is called, "everything you have ever wanted in a distributor." Your copy will be sent on request. Littleford Bros., 452 East Pearl St., Cincinnati, Ohio.

Hose and Belting

87. Complete information on rubber hose and belting for all types of contracting and road building service. The Government Sales Department of the Goodyear Tire & Rubber Co., Inc., Akron, Ohio.

Loaders and Unloaders

97. Portable Loaders and Unloaders. Folders: Nos. 1414 and 1074 cover Belt Conveyors with channel iron and truss types of framework; No. 1076, Portable Bucket elevators for different classes of work; and No. 1256, the "Grizzly" Crawler Loader for heavy work and large capacities. Link-Belt Company, 2045 W. Hunting Park Ave., Philadelphia, Pa.

Dirt Moving Efficency:

100. Where loading is done by hand, the Load Lugger, with your small truck, will cut costs tremendously. Simple, low in price. Especially adapted to city, county and town work. Complete details on request. Brooks Equipment & Mfg. Co., 56 Davenport Road, Knoxville, Tenn.

Motor Trucks

105. "What is Quality in a Motor Truck," is a new booklet containing valuable information for the prospective buyer of motor trucks. While this booklet refers especially to 1½ to 2-ton trucks, many of the facts contained in it are also applicable to heavy-duty units. Sent free on request by International Harvester Co., 180 North Michigan Ave., Chicago, Ill.

Mud-Jack Method

107. How the Mud-Jack Method for raising concrete curb, gutter, walls and streets solves problems of that kind quickly and economically without the usual cost and time-consuming reconstruction activities—a new bulletin by Koehring Company, 3026 West Concordia Ave., Milwaukee, Wis.

Paving Materials, Bituminous

112. Highway Engineers Asphalt Pocket Reference. This 236-page booklet, prepared by the Asphalt Institute, covers all phases of design and construction of asphalt highways and streets, describes paving equipment, gives specifications and describes methods of testing. A complete text on the subject sent on request by the Asphalt Institute, 801 Second Avenue, N. Y.

Paving Materials, Brick

116. Recommended standard specifications for vitrified brick pavements and brick parking strips and gutters, as submitted to the American Society of Municipal Engineers. If you contemplate using brick for paving, you should have a set. National Paving Brick Ass'n, Washington, D. C.

Paving Materials, Gutters

119. "Brick Gutters and Parking Strips." A study dealing with the problems faced in the proper construction of gutters and how they can be overcome. Covers design, construction and results. Well illustrated. Just issued by the National Paving Brick Ass'n, National Press Building, Washington, D. C.

Piling, Steel Sheet

120. A new catalog of corrugated steel sheet piling for sewerage, bridges, dams, levees, etc., has just been issued by Corrugated Steel Sheet Piling Corp., 228 North LaSalle St., Chicago, Ill.

Pumps

121. New illustrated catalog and prices of Jaeger Sure Prime Pumps, 2" to 10" sizes, 7000 to 220,000 G.P.H. capacities, also Jetting, Caisson, Road Pumps, recently issued by The Jaeger Machine Company, 400 Dublin Ave., Columbus, Ohio.

123. A new, 52 lb., midget, self-priming centrifugal pump which can be carried easily from job to job is described and illustrated in literature recently issued by Gorman-Rupp Co., Mansfield, Ohio.

Road Building and Maintenance

126. Action pictures show steps in road construction and maintenance, covering grading and ditching, rough grading, gravel and stone road construction, bituminous surfacing, fine grading and paving, summer and winter maintenance, municipal work and material handling, and illustrate Austin-Western equipment on such work. Ask for publication AD1655 Austin-Weston Road Machinery Co., Aurora, Ill.

Rollers

130. New bulletin describing in detail the new Huber Road Rollers will be sent promptly on request by the Huber Mfg. Co., Marion, Ohio.

132. The NEW Buffalo - Springfield Special Three-Axle Rollers for all kinds of precision rolling, especially of bituminous materials either hot or cold, are described in an illustrated pamphlet just issued by the Buffalo-Springfield Roller Co., Springfield, Ohio.

USE THIS COUPON

Readers Service Dept. 12-38
PUBLIC WORKS
310 East 45th St., NEW YORK

Please send me without obligation the following booklets listed in your READER'S SERVICE SECTION .....
(INDICATE BY NUMBERS)
.....

Name .....

Occupation .....

Street .....

City ..... State .....

Readers' Service Department

Use the coupon on Page 55 or send your request direct, mentioning Public Works Magazine.

CONTINUED FROM PAGE 55

Rollers, Light

133. New Tu-Ton roller of simple construction for use in rolling sidewalks along highways, playgrounds and other types of light rolling is fully described in a bulletin issued by C. H. & E. Mfg. Co., 3846 No. Palmer St., Milwaukee, Wis.

Sand and Gravel Washing Plants

140. Seventy-page catalog giving complete information regarding Sand and Gravel Washing Plants, stationary and portable. Those interested in such equipment should have a copy. Link-Belt Co., 307 No. Michigan Ave., Chicago, Ill.

Shovels, Cranes and Excavators

145. The Austin Badger, a new, fully convertible ½ yard crawler shovel, made by The Austin-Western Road Machinery Co., No. A-5 Aurora, Ill., is fully described and illustrated in their Bulletin No. AD-1683.

Spreader

147. Jaeger Paving Equipment, including Mix-in-Place Roadbuilders, Bituminous Pavers, Concrete Bituminous Finishers, Adjustable Spreaders, Forms, etc.—4 complete catalogs of latest equipment in one cover, issued by The Jaeger Machine Company, 400 Dublin Ave., Columbus, Ohio.

Soil Stabilization

150. "High-Service, Low Cost Roads" is one of the newer booklets using an effective combination of picture and text to set forth the principles and advantages of road surface stabilization with calcium chloride. Complete, interesting and well illustrated. 34 pages. Sent by Solvay Sales Corp., 40 Rector St., New York, N. Y.

152. The Columbia Alkali Corporation, Barberton, Ohio, will be glad to furnish to anyone interested complete information dealing with Calcium Chloride Stabilized Roads. This literature contains many charts, tables and useful information and can be obtained by writing The Columbia Alkali Corporation, Barberton, Ohio.

Tires, Truck and Tractor

165. Speed and economy in use of solid, cushion and pneumatic tires and tubes for trucks, cars, tractors, graders and other road machinery. Government Sales Department of the Goodyear Tire & Rubber Company, Inc., Akron, Ohio.

Tractors—Diesel and Gasoline

183. Case big capacity, heavy-duty, 4-speed special tractor made expressly for all year road work is described and illustrated in action in bulletin A-5037D issued by J. I. Case Co., Racine, Wis.

185. The various applications of Cleveland tractors to economical grading, road maintenance, bull-dozing, dirt moving, pipe handling and other work are illustrated in a booklet issued by Cleveland Tractor Co., Cleveland, O.

186. The new A-C *controlled ignition* oil tractor, the first tractor to combine gasoline engine simplicity and smoothness with fuel oil economy, is described in an illustrated bulletin recently issued by Tractor Division, Allis Chalmers Mfg. Co., Milwaukee, Wis.

Street and Paving Maintenance

Asphalt Heaters

198. Illustrated manual No. 11 describes "Hotstuf," the master oil burning heater. The only heater with patented elevated melting chamber for Asphalt, Tar and all bitumens used in road and street construction and maintenance, roofing, water proofing, pipe coating, etc. Mohawk Asphalt Heater Co., Frankfort, N. Y.

Dust Control

210. "How to Maintain Roads with Dowflake" is a new 58 page illustrated booklet of information on stabilized road construction. Includes specifications and several pages of reference tables from an engineer's notebook. Issued by Dow Chemical Co., Midland, Mich.

211. A complete booklet on dust control titled, "Dust Control and Road Stabilization," describes the use of Columbia Calcium Chloride for dust control purposes and stabilization of roads. Sent on request by The Columbia Alkali Corp., Barberton, Ohio.

Jacking Culverts

260. No interruption to traffic, and substantial savings in construction costs are the main advantages secured by using the Armco jacking method to install conduits, drainage openings, and passageways under streets, highways and railroads. "The Armco Jacking Method," describing this modern means of construction and its many applications, will be sent upon request, by Armco Culvert Mfrs. Association, Middletown, Ohio. Ask for Catalog No. 7.

Traffic Markers

275. How the Littleford "Traf-O-Spray" puts down a clean-cut traffic mark on any type of pavement regardless of condition of surface, is explained and illustrated in a new bulletin issued by Littleford Bros., 452 East Pearl St., Cincinnati, Ohio.

Manhole Cover Silencers

285. Free test length of TAPAX (enough to completely silence one rattling manhole cover) and full information regarding this inexpensive, easy-to-use material will be sent promptly on request to Trohn's Supplies, Inc., 205 Hoyt Ave., Mamaroneck, N. Y.

Snow Fighting

Calcium Chloride

347. The Solvay Plus Four Treatment—"a low-cost skidproofing method that meets today's driving needs" is described and illustrated in a timely new bulletin just issued by Solvay Sales Corp., 40 Rector St., New York, N. Y.

Plows—Small

348. For sidewalks and hard-to-get-at places, the Gravely adjustable sidewalk snow plow is just the thing. Get illustrated bulletin giving full details from Gravely Manufacturing Co., P. O. Box 916, Dunbar, West Va.

Plows

349. "V Type Sno-Plows for Every Size Motor Truck" describes and illustrates all features of the Frink V type plow, including the new power hydraulic control as well as the earlier types of lifting devices. Also describes and illustrates 14 styles of leveling wings and the different attachments which may be used in connection with them. Just issued by Carl H. Frink, Mfr., Clayton, N. Y.

350. One-Way Speed Sno-Plows are illustrated and described in a 4-page catalog. Features, specifications, methods of attaching. Carl H. Frink, Clayton, N. Y.

351. 36-page booklet on snow plows, with data on use, descriptions and specifications. Covers V, One-Way and Reversible plows for trucks; separate booklet covers tractor plows. Ask for Booklet 592. Baker Mfg. Co., Springfield, Ill.

Salt

352. "Make Icy Pavements Safe With Rock Salt" is an excellent, authoritative booklet describing one of the most effective and economical methods of winter ice control well illustrated. International Salt Co., Scranton, Pa.

Sanitary Engineering

Analysis of Water

360. "Methods of Analyzing Water for Municipal and Industrial Use," is an excellent 94 page booklet with many useful tables and formulas. Sent on request by Solvay Sales Corp., 40 Rector St., New York, N. Y.

Activation and Aeration

375. This concise folder No. 1294 describes "Straightline Aerators" for activated sludge treatment; combines the best points of the two types used in English plants: 1, rapid circulation in the tanks; 2, exposure of large surfaces, hastened oxidation and bacteriological growth. Link-Belt Co., 307 N. Michigan Avenue, Chicago, Illinois.

380. A valuable booklet on porous plates and porous tubes. Covers permeability, porosity, pore size and pressure loss data, with curves. Also information on installations, with sketches and pictures, specifications, methods of cleaning and studies in permeability. 20pp. illustrated. Sent on request to Norton Company, Worcester, Mass.

Aerators for Sewage

381. New 24 page booklet, No. 6571, describes and illustrates the Dorrco Paddle Aerator and also the Turbo-Aerator. Also contains a discussion of the activated sludge method of treatment with much interesting data and illustrations, including a section of "Useful Information." Issued by The Dorr Co., 570 Lexington Ave., New York, N. Y.

Air for Agitation

382. Positive displacement blowers, by Roots-Connersville, for moving air under moderate pressure or vacuum in volumes up to 700 cu. ft. per minute are described in Bulletin 21-B-19 recently issued by the Roots-Connersville Blower Corp., Connersville, Ind. Includes charts showing characteristics of machines at constant and variable speeds, table of capacities, etc.

Cast Iron Sewers

384. Cast Iron Pipe for Sewers. For wet grounds, under highways and railways and other severe duty. Details and specifications. U. S. Pipe & Foundry Co., Burlington, N. J.

385. For use in wet ground to prevent infiltration, for crossing under railways and heavy duty highways, and for all other sewer construction where replacement, repairs or reconstruction would be costly, cast iron pipe is most economical. For details, specifications, etc., write Thomas F. Wolfe, Cast Iron Pipe Research Ass'n, 1013 Peoples Gas Bldg., Chicago, Ill.

Feeders, Chlorine and Chemical

387. For chlorinating small water supplies, swimming pools and other installations. Flow of water controls dosage of chlorine (or other chemicals) providing required dosages, which are immediately adjustable. Driving is started and stopped automatically. Send for newest literature. %Proportioneers%, 9 Codding St., Providence, R. I.

Filter Plant Controllers

388. "The Modern Filter Plant" and the uses of Simplex Controllers for operation are described in a handy, 16-page booklet. Charts, data, curves and tables. Simplex Valve and Meter Co., 68th and Upland Sts., Philadelphia, Pa.

Readers' Service Department

These booklets are FREE to readers of PUBLIC WORKS.

CONTINUED FROM PAGE 56

Flow Meters

389. The primary devices for flow measurement—the orifice, the pilot tube, the venturi meter and others—and the application to them of the Simplex meter are described in a useful 24-page booklet (42A). Simplex Valve and Meter Co., 68th and Upland Sts., Philadelphia, Pa.

Gate Valves and Hydrants

390. An 84-page catalog gives full design data, information about and illustrations of the complete line of Darling Gate Valves and Hydrants. Write for one to Darling Valve and Mfg. Co., Williamsport, Pa.

Indicators, Rate of Flow

400. This rate of flow indicator is a new, simple, compact, ruggedly constructed instrument which indicates flow with great accuracy in filtration and softening. Described and illustrated in new bulletin issued by The Permutit Company, 330 West 42nd St., New York, N. Y.

Manhole Covers and Inlets

404. Street, sewer and water castings made of wear-resisting chilled iron in various styles, sizes and weights. Manhole covers, water meter covers, adjustable curb inlets, gutter, crossing plates, valve and lamphole covers, ventilators, etc. Described in catalog issued by South Bend Foundry Co., South Bend, Ind.

Pipe, Cast Iron

406. Data on cast iron pipe for water works systems, in sizes from 1¼ to 84 inches, including information on useful life, flow data, dimensions, etc., Thos. F. Wolfe, Cast Iron Pipe Research Ass'n, 1013 Peoples Gas Bldg., Chicago, Ill.

Pipe, 2-inch Cast Iron

407. The new McWane 2" cast iron pipe in 18-foot lengths has innumerable uses in water and sewage work. Send for the new McWane bulletin describing this pipe, the various joints used, and other details about it. McWane Cast Iron Pipe Co., Birmingham, Ala.

Pipe Forms

411. Making concrete pipe on the job to give employment at home is the subject of a new booklet just issued by Quinn Wire and Iron Works, 1621 Twelfth St., Boone, Ia., manufacturers of "Heavy Duty" Pipe Forms. Sent promptly on request.

Pipe Joints, Sewer

415. How to make a perfect sewer pipe joint—tight, prevents roots entering sewer, keeps lengths perfectly aligned; can be laid with water in trench or pipe. General instructions issued by L. A. Weston, Adams, Mass.

Taste and Odor Control

417. How, when, and where activated carbon can and should be used to remove all kinds of tastes and odors from water supplies is told in a booklet issued by Industrial Chemical Sales Div., 230 Park Ave., New York, N. Y. 77 pages, table, illustrations and usable data.

Pumps and Well Water Systems

420. Installation views and sectional scenes on Layne Vertical Centrifugal and Vertical Turbine Pumps, fully illustrated and including useful engineering data section. Layne Shutter Screens for Gravel Wall Wells. Write for these three descriptive booklets. Layne & Bowler, Inc., Dept. W, General Office Memphis, Tenn.

Pumping Engines

424. "When Power Is Down," gives recommendations of models for standby services for all power requirements. Sterling Engine Company, Buffalo, N. Y.

Run-off and Stream-Flow

426. Excellent booklet describes and illustrates the latest types of instruments for measuring run-off, both from small areas for storm sewer design, and from large areas for determining water shed yield. Sent promptly by Julien P. Friez & Sons, Baltimore, Md.

Screens, Sewage

428. Be assured of uninterrupted, constant automatic removal of screenings. Folder 1587 tells how. Gives some of the outstanding advantages of "Straightline Bar Screens" (Vertical and Inclined types). Link-Belt Co., 307 N. Michigan Avenue, Chicago, Ill.

Setting and Testing Equipment for Water Meters

430. All about setting and testing equipment for Water Meters—a beautifully printed and illustrated 40 page booklet giving full details concerning Ford setting and testing apparatus for all climates. Ford Meter Box Co., Wabash, Ind.

Rainfall Measurement

432. The measurement of precipitation, exposure of gauges, description of apparatus for measuring rainfall, both rates and amounts. Bulletin RG and Instruction Booklet. Julien P. Friez & Sons, Baltimore, Md.

Screens

435. Water Screen Book No. 1252, describes traveling water intake screens and gives complete technical information about them. Link-Belt Co., 307 No. Michigan Ave., Chicago, Ill.

Sewage Filters, Magnetite

436. Well illustrated booklet describes the magnetite filter, and tells how it is used in the treatment of Sewage. Copy on request from Filtration Equipment Corp., 10 East 40th St., New York, N. Y.

Small Septic Tanks

438. Septic Disposal Systems, Waterless Toilets, Multiple Toilets for Camps and Resorts, and other products for providing safer sewage disposal for unsewered areas are described and illustrated in data sheets issued by San-Equip, Inc., 700 Brighton Ave., Syracuse, N. Y.

Sludge Drying and Incineration

439. The five basic steps of: sludge preparation; flash drying; incineration; deodorization; and dust collection are explained in a new 24 page booklet, No. 6781 issued by The Dorr Company, 570 Lexington Ave., New York, N. Y.

440. Disposal of Municipal Refuse: Planning a disposal system; specifications. The production of refuse, weights, volume, characteristics. Fuel requirements for incineration. Suggestions for plant inspection, 45 pp., ill. Also detailed outline of factors involved in preparation of plans and specifications. Morse-Boulger Destructor Co., 202P East 44th St., N. Y.

Swimming Pool Equipment

444. A new booklet "Essential Factors in the Design and Layout of Swimming Pool Systems," with data on filtration equipment, fittings, solution feeders, accessories, etc., is available from Everson Manufacturing Co., 213 West Huron St., Chicago, Ill.

445. Data and complete information on swimming pool filters and recirculation plants; also on water filters and filtration equipment. For data, prices, plans, etc., write Roberts Filter Mfg. Co., 640 Columbia Ave., Darby, Pa.

446. 40-page Manual on swimming pools. Includes swimming pool layouts, specifications, etc., and details concerning Permutit Swimming Pool Equipment. Write The Permutit Co., Dept. G-4, 330 West 42 St., New York, N. Y.

Treatment

450. Standard Sewage Siphons for small disposal plants and PFT Rotary Distributors are new catalogs recently issued by Pacific Flush Tank Co., 4241 Ravenswood Ave., Chicago, Ill. The latter catalog contains typical plans and many illustrations of actual installations.

453. New booklet on Link-Belt Circuline Collectors for Settling Tanks contains excellent pictures and drawings of installations, sanitary engineering data and design details. Link-Belt Company, 307 North Michigan Ave., Chicago, Ill.

Water & Sewage Treatment Chemicals

500. Aluminum sulphate and ferric chloride for sewage coagulation, and these chemicals and ammonia, copper sulphate and others for water treatment. Information on uses and methods sent on request to General Chemical Co., 40 Rector St., New York, N. Y.

501. "Ferrisul for water and sewage treatment." What it is; what it will do for you and how to use it—a handy booklet issued by Merrimac Chemical Co., Everett Station, Boston, Mass.

Valve Box Tops

475. "Cut the Cost, but Not the Pavement," is the theme of a new bulletin on Rite-Hite Valve Box Tops. Gives directions for forming new tops on valve boxes, quickly and inexpensively without digging up the old box. Just issued by Trohn's Supplies, Inc., 205 Hoyt Ave., Mamaroneck, N. Y.

Water Works Operating Practices

490. "What Is New In Coagulation" is an excellent, new review with bibliography and outlines of latest work done in the field. Written by Burton W. Graham and sent free on request to Activated Alum Corp., Curtis Bay, Baltimore, Md.

For the Engineer's Library

Brief reviews of the latest books, booklets and catalogs for the public works engineer.

Algae in Water:

George J. Turre, sanitary engineer, Board of Water Commissioners, Denver, Col., made quite a stir at the New Orleans AWWA meeting with his photographs of algae. Many of these are reproduced in Taste & Odor Control, Vol. 4, No. 11, published by Industrial Chemical Sales, 230 Park Ave., New York, N. Y. We are sure this will be sent on request.

Truck Lubrication:

This 45-page, spiral bound, paper covered, text is published by the Chek-Chart Corp., 624 So. Michigan Ave., Chicago, Ill. It analyzes the motor truck market for fuels, lubricants, etc., estimated at over 3 billion gallons of gas, 76 million gallons of motor oil, 11 million gallons of gear oil and 19,000 tons of chassis lubricant annually.

Water and Sewage:

International Filter Co., 59 E. Van Buren St., Chicago, Ill., has issued 3 new bulletins of interest to engineers. No. 1820, 12 pages, tells of the "Accelator" for water softening, with descriptions, details and diagrams. No. 1700 covers Hydrodarco purifiers for the removal of taste and odor. No. 2410-A covers rotary distributors for sewage treatment. Any or all sent on request.

Damage From Runoff:

Leaflet 164, which can be obtained from the Department of Agriculture, Washington, D. C., covers the damage that runoff water may cause to highways and adjacent lands. Pictures show the damage that may be done. Presumably the text tells how to prevent these. We have not yet seen a copy of the leaflet.

Comminutor:

A new bulletin, describing their comminutor in detail, has been issued by the Chicago Pump Co., 2338 Wolfram St., Chicago, Ill. This contains much information on design and use, and shows blueprints of a number of installations. An excellent publication. Ask for Bulletin 185.

Water Supply and Purification:

This book of 445 pages is the most up-to-date text on the subject; as an illustration it describes the use of "dry ice" for clearing a deep well screen—a quite recent development. It is authoritative—was written by an engineer who has had many years experience as a sanitary engineer and also in public health work, and who is now Lt. Col. in the Sanitary Reserve, U. S. army. It is comprehensive—treats of planning a system, in all its details, constructing it, and examining and purifying water (186 pages are devoted to this subject). It is designed to aid the student in applying engineering principles to water works design, for which purpose numerous "examples for practice" are given in almost every chapter. Modern equipment and materials are described quite fully. Special emphasis has been placed on supplying pure and palatable water. The author is W. A. Hardenbergh, M. Am. Soc. C.E., Assoc. Editor of *Public Works*. It is published by the International Textbook Co. Price $4.00.

New Publications And Booklets

Contractors pumping equipment is described, and uses illustrated, in a new catalog, No. 1040, just issued by Ralph V. Carter Co., 53 Park Place, New York, N. Y.

"Diesel power at a touch" is a new booklet on the uses and advantages of the Cleveland Tractor electric starting diesels. Cleveland Tractor Co., Cleveland, Ohio.

"Water Conditioning"—5 new booklets by the Permutit Co., 330 W. 42nd St., N. Y., as follows: Permutit Zeo-Karb—A non-technical treatise on Permutit's new carbonaceous zeolite—its applications and operating principles. Permutit Rate of Flow Indicator—Describes the new Permutit Rate of Flow Indicator with specifications. No mercury to lose—no moving parts exposed to water. Permutit Operating Cabinets and Tables—Outlines four types of master valve control for water softeners and filters. Complete with specifications. Permutit Multiport Valve—Automatic, semi-automatic and manual. An uniquely designed valve one of which replaces nine gate type valves formerly employed on softeners and filters. (Specs.) Permutit Degasifier—A proved new development in forced draft aeration; high efficiency; completely enclosed. (Specs.)